

November 18, 2016

2016-3534

Ms. Kelly Owens
Associate Supervising Engineer
Rhode Island Department of Environmental Management
Office of Waste Management
235 Promenade Street
Providence, RI 02908

Mr. Frank Battaglia
USEPA Region 1
5 Post Office Square, Suite 100, OSRR07-3
Boston, MA 02109

RE: In-situ Ozone Injection Pilot Test Workplan
Ciba-Geigy RCRA Closure Project
Former Ciba-Geigy Facility, 180 Mill Street, Cranston, RI
Corrective Action Area- Former Production Area

Dear Ms. Owens and Mr. Battaglia:

BASF has been performing Resource Conservation and Recovery Act (RCRA) closure activities at the former Ciba-Geigy (Ciba) facility located at 180 Mill Street, Cranston, Rhode Island under the oversight of United States Environmental Protection Agency (USEPA) Region I. The current USEPA RCRA Facility Manager is Mr. Frank Battaglia.

The EPA approved RCRA Corrective Action for the groundwater at the area identified as the former production area (FPA) is to inject ozone into the subsurface. The remedy is summarized in the Site's Statement of Basis (SOB), available for review on the EPA's project web site:
<https://semspub.epa.gov/src/collection/01/AR64497>

The goal of the remedial activities in this area is to address groundwater impacts utilizing an ozone curtain wall. The scope of work for the groundwater includes planning and performing an ozone pilot study and based on the results of that study, design and install the full scale treatment system. This document provides the scope of the Pilot Study for approval by the RIDEM and the EPA. It has been prepared in accordance with the State of Rhode Island and Providence Plantations, Department of Environmental Management, Office of Waste Management, Rules and Regulations for the Investigation and Remediation of Hazardous Material Releases DEM-DSR-01-93 amended November 2011, Rule 9.0 Remedial Action Workplans.



SITE HISTORY

The above-referenced SOB provides a complete summary of site use history, remedial investigation activities, and proposed remedial alternatives. It is included as **Attachment A**.

GROUNDWATER REMEDIATION OBJECTIVES

The groundwater remedy for the Site has the following objectives:

- Maintain compliance with regulatory consent orders and RCRA Corrective Action.
- Reduce groundwater impacts by addressing identified residual impacts acting as ongoing sources.
- Reduce groundwater impacts in the Former Production Area (FPA) to below applicable standards including chlorinated ethenes and benzenes that are collocated with Site compounds of concern (COCs) in groundwater.
- Reduce impacts to the Pawtuxet River sediment by treating groundwater transported in permeable pathways in the vicinity of the bulkhead wall, such that COC concentrations in shallow and deep groundwater potentially discharging to the river are below applicable criteria.

This in-situ ozone injection pilot test focuses on the last two bullet points above.

GROUNDWATER REGULATIONS & STANDARDS

Site-related groundwater is classified by the RIDEM as GB, which is not suitable for use as a current or potential source of drinking water. The Remediation Regulations contain numerical, default criteria for contaminated GB groundwater associated with a release area. The criteria are established to be protective of human health (from contaminants that may volatilize from contaminated groundwater) and the environment (from contaminants that may adversely affect surface water resources).

The Rhode Island Remediation Regulations (Remediation Regulations [RIDEM, 2011]) and site-specific Media Protection Standards (MPS) provide the applicable clean-up criteria for groundwater at the properties under the RCRA Corrective Action program. For the FPA potentially unacceptable ecological risks were identified for benthos organism exposure from site-related VOC impacted groundwater discharge into river sediment. To mitigate this impact and provide a basis for necessary Interim Remedial Measures (IRM), site-specific Media Protection Standards (MPS) were developed for five site-related compounds: toluene (1,700 ppb), 2-chlorotoluene (1,500 ppb), 1, 2-dichlorobenzene (94 ppb), chlorobenzene (1,700 ppb), and total xylenes (76 ppb). The MPS for these COCs, except toluene, were based on benthic invertebrate



Toxicity Reference Values (TRVs) and developed to be protective of benthic organisms as site-related groundwater discharges to the river. For toluene, the MPS was based on the RI GB Groundwater Objective because it was a lower value, and thus, more protective.

PROPOSED REMEDY

In-situ chemical oxidation (ISCO) remediates contaminants by incorporating them into oxidation reactions. Chemical oxidants are injected into the aquifer, which chemically oxidize the COCs in the source and groundwater.

For the groundwater plume that has migrated to the vicinity of the river bulkhead, an in-situ reactive barrier is proposed to be installed parallel to the river bulkhead and normal to the groundwater flow direction to destroy VOC mass in-situ before it migrates off-site and discharges to the Pawtuxet River. The proposed oxidant is ozone, and it will be applied to the aquifer in a continuous fashion using a line of wells that overlap in their volume of influence (a sparge application). The remedy will be run on the order of years until such time as upgradient and downgradient monitoring show that the media protection standards have been met. The ozone will destroy all contamination in which it comes in contact, and it will also contribute oxygen to the groundwater to support aerobic biological degradation. The remedy design including the treatment volume, number and orientation of injection wells, and monitoring requirements will be determined from a pilot testing program.

OZONE BASICS

This section briefly describes ozone, the advantages and limitations of ozone as a chemical oxidant to remediate chlorinated and volatile organic compounds. **Attachment B** contains basic ozone property information and the safety data sheets (SDS) for Ozone.

Ozone is a strong oxidant that has been used in subsurface remediation targeting both unsaturated and saturated zones. Ozone is a gas (triatomic oxygen- O^3). The water solubility of ozone is 13 times higher than oxygen (O^3 0.64 gram/100 milliliters verses O^2 0.049 gram/100 milliliters). Similar to hydrogen peroxide, ozone oxidation does not leave a residue (such as sulfate from persulfate or manganese dioxide from permanganate). Ozone has the strongest oxidation potential of any single compound. Ozone is unstable (half-life of minutes to hours) and requires generation on site, and continuous to periodic injections during the remediation phase. As indicated by ITRC, use of ozone may be beneficial in low-permeability environments where gas phase permeability is typically greater than liquid phase permeability. The BASF site contains lenses of low-permeability soils.

Ozone in the air can cause short-term health hazards such as shortness of breath, headache, harsh breathing and sever pain in lungs (at levels above 1.0 part per million). Ozone monitors are used to detect a leak of ozone. Fortunately, ozone gas can be detected by human senses well before they reach levels that are harmful. Though, long-term exposure can desensitize human senses.



OZONE PILOT-TEST PROGRAM

Advanced GeoServices will conduct an ozone pilot-test using a mobile trailer-mounted ozone generation system. The proposed pilot test will extend for up to five (5) consecutive days.

The main components of the ozone injection system are contained within a pre-fabricated trailer. A portable generator will be utilized to power the Ozone Trailer. The main ozone equipment will contain the following:

- Liquid oxygen tank with pressure regulator.
- Two (2) air cooled ozone generators capable of producing 40 gram/hour (g/hr) each of ozone at 4.7% by weight produced from 20 liters per minute (LPM) of oxygen.
- Ozone distribution panel with dry air sparge option to boost injection pressures, if necessary.
- Ozone analyzer 0- 200 grams per cubic meter.
- Mass and visual flow meters and regulating valves to set and control flow rates and pressures.
- Ozone injection well kits containing packers and diffusers.

Injection Wells

Existing air sparge wells AS-1 and AS-2, installed as part of an air sparge pilot test in 2011, will be converted into ozone injection wells. These wells were selected as they represent different screened intervals and geology. Both air sparge wells are 2-inch in diameter PVC construction. AS-1 extends 40 feet below the ground surface and is screened from 38 to 40 feet. AS-2 extends 21 feet below the ground surface and is screened from 19 to 21 feet. AS-1 is considered the deeper groundwater bearing zone, which is below a lens of denser less permeable soils. AS-2 is the shallow groundwater zone located above the denser less permeable soils. Please note that the bulkhead wall extends to approximately 25 feet below ground surface. However, it is believed that the contaminants in the shallower groundwater zone will dive beneath the bulkhead wall and enter the river. The pilot test will address both water bearing zones.

The key to a successful in-situ ozone injection system is the mass transfer of ozone gas into the groundwater and dispersing it throughout the saturated zone. To accomplish this mass transfer, 20 micron stainless steel diffusers will be used. To temporarily convert an existing monitoring well into an injection well a packer will be inserted above the top of open screen. The 20 micron stainless steel diffuser is connected to the underside of the packer. Ozone resistant tubing is connected from the outlet of the ozone generator to the diffuser.

Pilot Test Observation Wells

Existing monitoring wells will be used to field monitor the performance of the ozone injection system and to determine a radius of influence of the injection system. This is accomplished by



recording influence and changes in water parameters (e.g., pH, ORP, conductivity, dissolved oxygen, turbidity and temperature) as a result of the ozone injection process. **Table 1** identifies the injection wells and the proposed surrounding monitoring wells to be field monitored during the pilot-test. **Figure 5 and D1** from AECOMs Corrective Measures Study (CMS), included herein, identify the groundwater area of concern at the FPA and a geologic cross section. **Attachment C** contains excerpts from AECOM's Supplemental Investigation Report that discuss the groundwater conditions at the FPA.

Pre-startup pilot-testing includes collecting baseline groundwater field parameters from the injection well and the surrounding well network for pH, ORP, conductivity, dissolved oxygen, turbidity and temperature. pH is measured to determine if it is in the desired range and to determine any slight changes through the breakdown of chlorinated compounds. DO is measured in order to monitor oxygen as a breakdown product, such as oxygen from ozone reactions. Temperature is an indicator of exothermic reactions. Conductivity is a general indicator of oxidant distribution.

Groundwater baseline samples will be collected and analyzed by a third-party laboratory for volatile organic compounds (VOCs) from six (6) monitoring wells within the area; three (3) representing the deeper water bearing zone and three (3) from the shallower water bearing zone.

At the conclusion of the pilot test, these same six (6) monitoring wells will have the groundwater re-sampled and analyzed for volatile organic compounds. These results will provide an indication of the effectiveness of the ozone to breakdown the contaminants of concern within this specific geologic formation, and to determine ozone injection mass and radius of influence requirements for a full-scale system.

Ozone Pilot Test Reporting

The pilot-test data will be compiled and evaluated. Injection radius of influence, ozone dosage rates and injection pressures will be calculated and provided. The summary report will provide a recommendation as to whether the ozone injection pilot test was successful, and the design of a full-scale system should be conducted. The Summary Report will be available approximately four (4) weeks after receipt of the analytical data.

PROJECT SCHEDULE

The desire is to perform the pilot test mid- December 2016, assuming regulatory approval is obtained. The pilot test will operate for up to five (5) consecutive days. Assuming fast-track approval, the tentative schedule is as follows:

- RIDEM pilot test approval by December 6th 2016
- Pilot test December 12th- 16th 2016
- Groundwater analytical results by January 3rd 2017 (accounting for holidays)
- Summary Report February 1, 2017

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Please feel free to contact the undersigned for any questions on the ozone pilot test remedial action workplan (call 610-840-9162 or 856-354-2273 or email: tlegel@advancedgeoservices.com or rshoyer@advancedgeoservices.com). To facilitate Plan review, a conference call and or webinar can be arranged.

Sincerely,

ADVANCED GEOSERVICES CORP.

Frederick J. Shoyer
Sr. Project Consultant

Thomas M. Legel, PE
Executive Vice President

FJS:TML:kk

Attachments

- Table- 1 Construction Well Table with proposed Injection & Monitoring Wells
- Figures 5 & D-1 FPA- Wells & Cross Section
- Attachment A- RCRA Corrective Action Statement of Basis
- Attachment B- Ozone Basics and MSDS
- Attachment C- excerpts from AECOM's Supplemental Investigation Report



TABLE



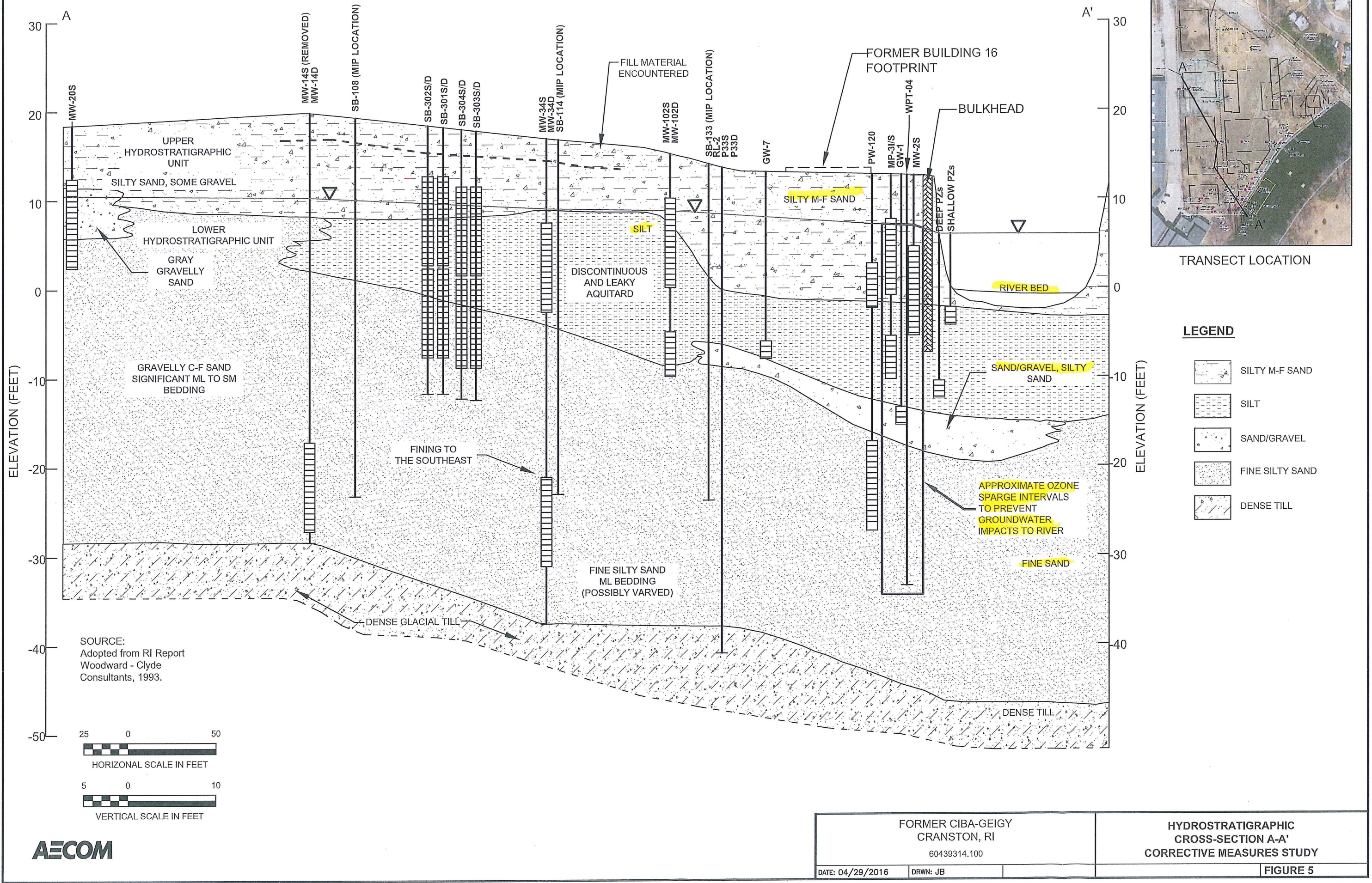
TABLE 1
Proposed Ozone Injection Wells Monitoring Wells

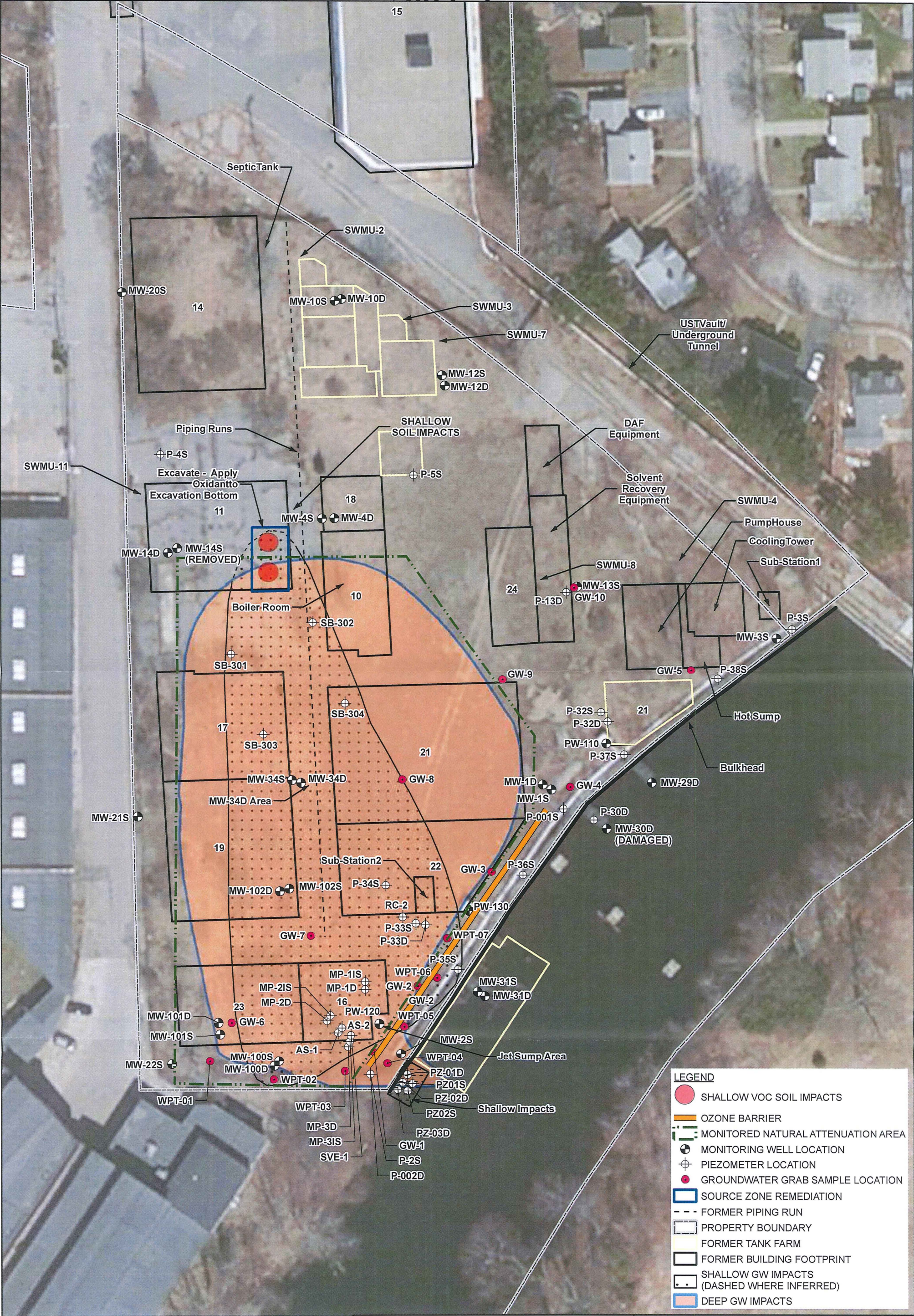
Proposed Pilot Test Wells & Monitoring Points																
									Monitoring Well/Piezometer Data							
	Well/ Piezometer Number	Area	Month/ Year of Installation	Radius of Riser	Location Data		Elevation Data		Boring Data		Bottom of Monitoring Zone		Top of Monitoring Zone		Length of Screen	Strata Monitored
					Northing	Easting	Ground Surface	Top of Riser Pipe	Depth	Bottom Elevation	Depth	Elevation	Depth	Elevation		
Pilot Test Deeper Zone																
IJ Well	AS-1	Production	5/11	2"					40.00		40.00		38.00			UD
MP	P-2D	Production	6/92	1-1/4"	248705.76	523891.36	12.96	16.00	52.00	-39.04	49.00	-36.04	46.00	-33.04	3.00	UD
MP	PW-120 (RC-5)	Production	7/93	6"	248715.22	523892.45	12.90	14.25	52.00	-39.10	40.00	-27.10	10.00	2.90	15.00	UD
MP	P-1D	Production	4/88	1-1/4"	248841.66	523999.27	13.59	16.33	49.50	-35.91	43.00	-29.41	40.00	-26.41	3.00	UD
MP	MP-2D	Production	5/11	1.5"					32.00		32.00		28.00		4.00	
MP	MP-1D	Production	5/11	1.5"					32.00		32.00		28.00		4.00	
MP	MP-3D	Production	5/11	1.5"					32.00		32.00		28.00		4.00	
Pilot Test Shallow Zone																
IJ Well	AS-2	Production	5/11	2"					21.00		21.00		19.00		2.00	UD
MP	MW-21S	Production	6/92	4"	248833.96	523754.94	15.82	15.42	19.00	-3.18	16.00	-0.18	6.00	9.82	10.00	UD
MP	MW-2S	Production	5/88	4"	248697.91	523904.81	12.56	14.46	20.00	-7.44	18.00	-5.44	8.00	4.56	10.00	Fill
MP	P-2S	Production	4/88	1-1/4"	248685.97	523887.35	12.70	13.85	NA	NA	11.00	1.70	8.00	4.70	3.00	Fill
MP	SW-120(MW-31S)	Production	7/92	2"	248733.93	523948.45	©	16.27	NA	NA	25.50	-9.23	20.50	-4.23	5.00	UD
MP	MP-2I	Production	5/11	1.5"					22.00		22.00		18.00		4.00	
MP	MP-2S	Production	5/11	2"					13.00		13.00		5.00		8.00	
MP	MW-100D	Production	5/11	2"					25.00		25.00		20.00		5.00	
MP	MW-100S	Production	5/11	2"					15.00		15.00		5.00		10.00	
MP	MW-101D	Production	5/11	2"					25.00		25.00		20.00		5.00	
MP	MW-101S	Production	5/11	2"					15.00		15.00		5.00		10.00	
MP	MW-102D	Production	5/11	2"					25.00		25.00		20.00		5.00	
MP	MW-102S	Production	5/11	2"					15.00		15.00		5.00		10.00	
MP	MP-11	Production	5/11	1.5"					22.00		22.00		18.00		4.00	
MP	MP-1S	Production	5/11	2"					13.00		13.00		5.00		8.00	
MP	MP-3I	Production	5/11	1.5"					22.00		22.00		18.00		4.00	
MP	MP-3S	Production	5/11	2"					13.00		13.00		5.00		8.00	
IJ Well	AS-1	Proposed Injection Well					Wells installed between 1988 & 1993- data obtained from Table 2-3 Piezometer & Well Location & Construction Detail									
MP	PW-120 (RC-5)	Proposed Alternate Injection Well					Wells Installed May 2011- data obtained from well logs									
MP	P-2D	Proposed Monitoring Points- Collect Field Data														
©		Well located in River														
		GW Samples from select wells be collected and analyzed for VOCs														



FIGURES

File: P:\Jobs\Ined\Service\Project_Files\BASF-0760\Cranston_RI\Z_Deliverables\1. GIS_Database\GMD\CMS\HYDROSTRATIGRAPHY_CROSS_SECTIONS.dwg Layout: FIGURE 5 User: bourdeauj Plotted: Apr 29, 2016 - 1:53pm Xref's:







ATTACHMENT A

RCRA Corrective Action Statement of Basis

**U.S. Environmental Protection Agency (EPA) – Region 1
RCRA Corrective Action Program**

**Statement of Basis for the Proposed Remedy Determination
for the
Former Ciba-Geigy Facility
180 Mill Street, Cranston, Rhode Island**

May 25, 2016

This proposed Remedy Determination is based upon investigation and remediation activities conducted at the Former Ciba-Geigy Facility (Site) under the Resource Conservation and Recovery Act (RCRA) Corrective Action Program (RCRA Docket No. 1-88-1088, EPA ID No. RID001194323), located at 180 Mill Street in Cranston, Rhode Island. BASF, the current owner, has identified, developed, and evaluated several proposed remedial alternatives for on-site soil and groundwater. The evaluation was presented in the Corrective Measures Study (CMS) and this Statement of Basis (SOB) identifies the selected remedial actions to address polychlorinated biphenyls (PCBs), volatile organic compounds (VOCs), and semi-volatile organic compounds (SVOCs) in soil and VOCs in groundwater. EPA believes the proposed remedy, if implemented will be protective of human health and the environment under current and proposed site use.

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Introduction

The Site is a former chemical manufacturing facility operated by Ciba-Geigy from 1954 to 1986.

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The objective of this Statement of Basis is to present a proposed remedial alternative for the Former Ciba-Geigy Site at 180 Mill St, Cranston, RI (Site). The proposed remedial alternative emerged from a detailed evaluation of potential remedial options. This evaluation was completed in a February 2016 report called the Corrective Measures Study (CMS) [AECOM, 2016], approved by EPA in April 2016, where several remedial options were identified, developed and evaluated to address the impacted environmental media at the Site. This Statement of Basis describes the Site history, past remedial actions, and presents the proposed alternative under consideration.

This document summarizes the results of various investigation and remediation activities and the reasons that the proposed remedial alternative is appropriate. EPA is publishing this document to provide an opportunity for public review and comment on this proposal and will consider public comments as part of its decision making process. This document refers the reader to the administrative record, a compilation of EPA approved reports and work-plans, which contains more detailed information on site-specific activities. Specifically, the CMS identifies the remedial alternatives that were evaluated and the reasons for their selection.

This **Statement of Basis** is intended to:

- **Explain** the opportunity for **public participation**, including how you may comment on this proposed remedial alternative and where the public can find more detailed information;
- **Provide** a brief **description and history** of the Site;
- **Present the principal findings** of investigations and activities performed at the site; and
- **Present EPA's rationale** for why the proposed remedial alternative is protective of human health and the environment.

How Do You Participate

EPA solicits public review and comments prior to making a final decision on this proposed remedial alternative. All interested persons are invited to express their views on this proposal. This Statement of Basis provides only a summary of information about the Site and additional information, a list of which appears at the end of this Statement of Basis, can be found in the Administrative Record at the following locations:

EPA Region 1 Records Center, 5 Post Office Square, Boston, MA 02109

(617) 918-1420

Monday-Friday - 9:00 A.M. to 5:00 P.M.,

and on the EPA website at - <https://semspub.epa.gov/src/collection/01/AR64497>

Cranston (William Hall) Public Library, 1825 Broad Street, Cranston, RI 02905

(401) 781-2450

Monday-Thursday - 12:00 P.M. to 8:00 P.M: Saturday - 10:00 A.M. to 5:00 P.M.

Public Comment Period

The public comment period begins on **May 29, 2016** and ends 30 days later on **June 28, 2016**.

Written comments on this proposal will be accepted throughout the 30 day comment period. If, after reviewing the information on the Site, you would like to comment in writing on this proposal, or on any other issues related to this proposal, you should mail or email your comments to Frank Battaglia at the following address (postmarked no later than **June 28, 2016**) making sure to clearly indicate that you are commenting on this proposal:

Mr. Frank Battaglia

USEPA Region 1

5 Post Office Square, Suite 100, OSRR07-3

Boston, MA 02109

email: battaglia.frank@epa.gov Call 617 918-1362 if you have any questions.

At the end of the public comment period, EPA will review all written comments received. EPA will write a summary and response to all comments. The Response to Comments will be incorporated into the Administrative Record for the Site. EPA can modify the proposed final remedy, or select another remedy based on technical or legal issues brought up by the community's comments.

Facility Description and Regulatory History

The Site consists of two properties. The former manufacturing facility is located at 180 Mill Street in Cranston, Rhode Island, and the former Waste Water Treatment Area (FWWTA) is located on Mayflower Drive adjacent to the Pawtuxet River (**Figure 1**).

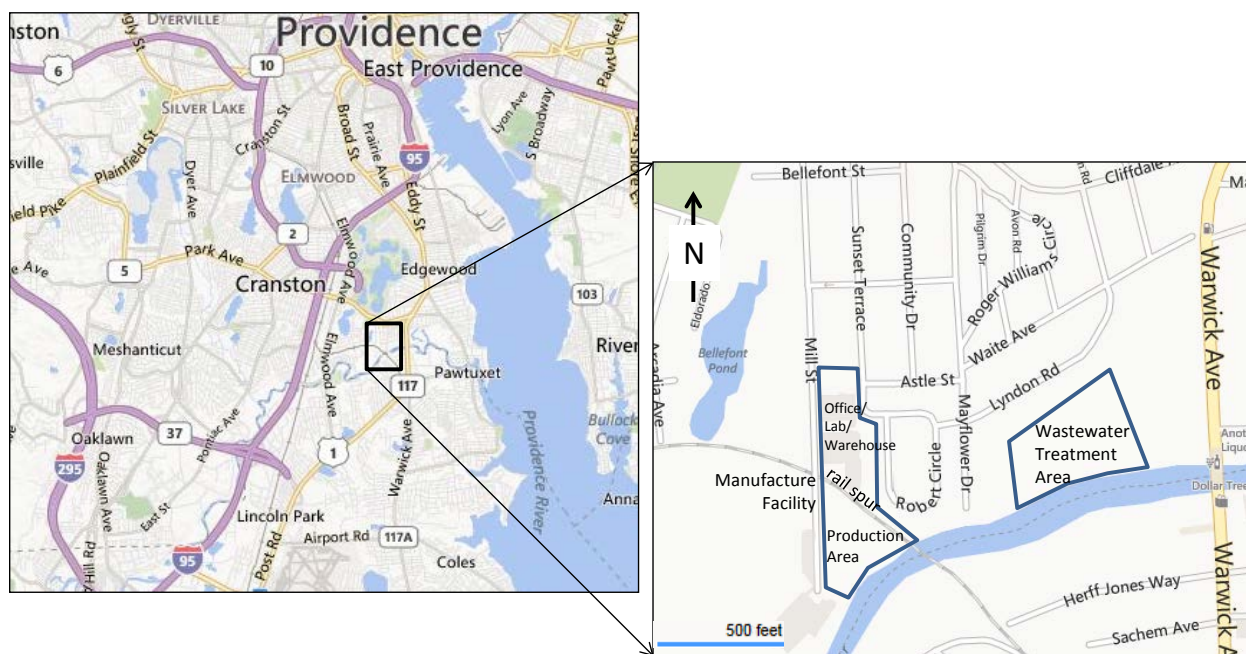


Figure 1 – RCRA Corrective Action Program Site location

The Site was developed for industrial use and manufactured organic chemicals, such as plastic additives, optical brighteners, pharmaceuticals, and textile auxiliaries. The Site stopped all chemical manufacturing operations in May 1986 when the plant was closed. The Site is bounded to the south by the Pawtuxet River, to the north and east by residential properties on Mill Street and Robert Circle, respectively, and to the west by industrial properties and undeveloped land. A site location map is provided as (**Figure 1**).

The facility was owned by Alrose Chemical Company beginning in 1930. It was sold to Geigy Corporation in 1954, then Ciba Corporation and Geigy Corporation merged in 1970 and became the Ciba-Geigy Corporation. In 1997 Ciba-Geigy became Ciba Specialty Chemicals (Ciba) after another corporate merger. In 2009, BASF acquired Ciba, and with it, BASF retains all regulatory responsibility for the Site.

The Site includes the Former Production Area (FPA) on the southern half of the property, where manufacturing buildings once existed and all chemicals were produced. This area is now vacant

and wooded. The Site also includes the Pawtuxet River sediments adjacent to the FPA and the Office / Warehouse / Laboratory Area (OWLA) on the northern portion of the Site (**Figure 2**). The office, warehouse, and former laboratory buildings are currently unoccupied. Finally, the Former Waste Water Treatment Area (FWWTA) was a separate property used by the facility to treat facility wastewater and discharge the treated water to the Pawtuxet River. This parcel was sold by Ciba to the adjacent tree nursery in 2004 and has been used for commercial operations associated with the tree nursery since that time (**Figure 1**).

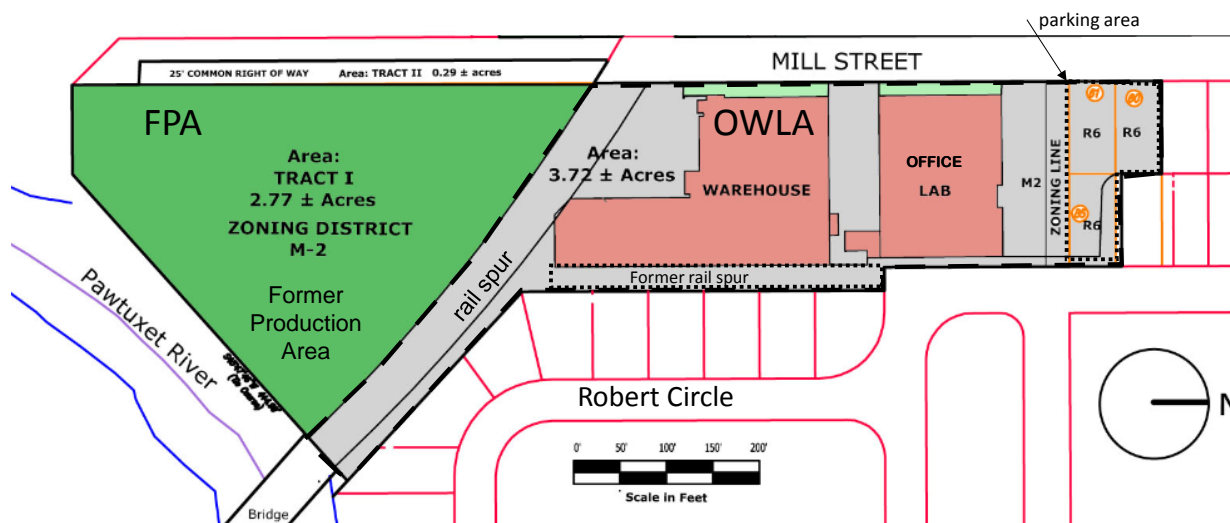


Figure 2 – Detail of the Former Production area (FPA) and the Office / Warehouse / Laboratory Area (OWLA).

Following closure in 1986, the former manufacturing buildings and underground tanks within the FPA were decontaminated, decommissioned and removed. Underground piping and a septic tank were cleaned and left in place. Concrete building footings and foundations were also left in place and the Site was graded and securely fenced. The former laboratory and warehouse buildings in the OWLA remain in place in the northern portion of the Site. **Figure 3** shows the current layout of the FPA and where historic site structures/features were located.

Investigation and remediation activities at the Site (discussed in the following Section) have been conducted by Ciba (now BASF) under continuous regulatory oversight of the USEPA since 1989 as part of the RCRA Corrective Action program documented in the following EPA regulatory orders:

- USEPA Consent Order RCRA No. I-88-1088 (1989); and
- USEPA Consent Order Modification to RCRA No. I-88-1088 (1992).

As detailed in the next section, from 1991 to 1995, with EPA oversight, Ciba-Geigy conducted several remedial investigations, and by 1996 it had implemented several necessary remedies on the FPA, called interim remedial measures (IRMs), including removing and capping facility-affected surface soils and sediment and removing and controlling groundwater impacted with

industrial solvents. No releases of hazardous wastes were identified on the OWLA to warrant remedial action under the RCRA Corrective Action program.

The remedies are called 'interim' because, while they provided protection of human health and the environment, they relied on what are called engineering controls to contain and remediate impacts that still remained on the property, and they recognized the fact that verification monitoring must be conducted, not only to ensure protectiveness of the remedies, but to verify that the full scope of the problem is well understood, and if not, what additional measures must be implemented. To these ends, from 1997 to 2009, Ciba, and from 2010 to the present, BASF, provided necessary and sufficient monitoring, maintenance and data gathering tasks to manage the IRMs and to propose additional remedial measures deemed necessary to achieve final RCRA Corrective Action Site closure.

Overview of Investigations and Remedial Work

As detailed in the Supplemental Remedial Investigation (SRI) report (AECOM, 2012 and 2014a), a multi-phase RCRA Facility Investigation (RFI) was completed between 1991 and 1996. The RFIs concluded that unacceptable human health and ecological risks were present primarily from polychlorinated biphenyls (PCB) and volatile organic compounds (VOC) impacts in FPA soil and adjacent river sediment. Media protection standards (MPS) were then derived for PCBs in soil and VOCs (chlorobenzene, 1, 2-dichlorobenzene, 2-chlorotoluene, xylenes, and toluene) in groundwater. In response, Interim Remedial Measures (IRM) were developed and implemented in 1995 and 1996. These included excavation and capping of PCB-impacted soil, removal of shallow soil VOC impacts via soil vapor extraction (SVE), collection (extraction wells) and treatment of VOC-impacted groundwater, and excavation and capping of impacted sediment. **Figure 3** shows the outlines of the areas on-Site where remediation has already occurred.

From 1996 to 2009, under EPA oversight, verification sampling was conducted by Ciba to confirm that the IRMs were functioning as intended. From 2010 to 2015 BASF conducted document review and RI tasks to validate IRM needs and effectiveness. This work is documented in the SRI Report (AECOM, 2012) and SRI Revision (AECOM, 2014a). SRI tasks included several rounds of soil, groundwater and sediment data collection and analysis. The results provided a refinement to the previous environmental impact characterization and no significant exposure concerns or additional environmental impacts were discovered, thus validating the previous work performed by Ciba.

From the BASF assessment, corrective measures for the remediation of remaining soil and groundwater impacts were screened for feasibility in the CMS Work Plan (AECOM 2014b), and they were evaluated in the CMS (AECOM 2016) to present alternatives that will achieve RCRA Corrective Action Site closure.

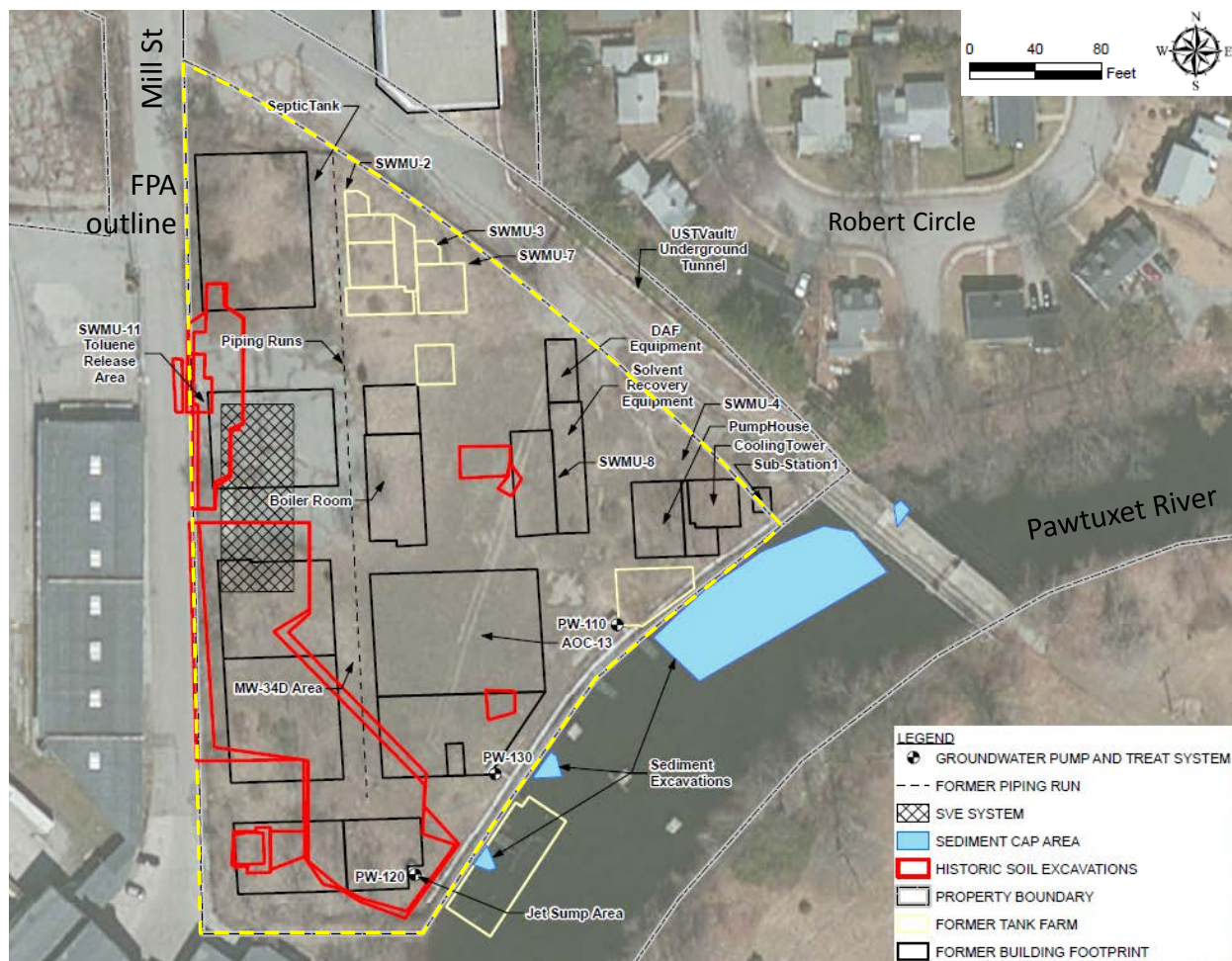


Figure 3 – Former Production Area and interim remedial measures implemented in 1995 and 1996.

Summary of Completed and Proposed Remedial Measures

As a result of the environmental investigations described above, numerous IRMs were implemented at the site in 1995 and 1996 to control sources of contamination, control the spread of contamination, and control potential human and ecological exposures from impacted soil, sediment and groundwater.

A description of IRMs is included in the “Remedial Action History Summary” section of the CMS (AECOM, 2016). The remedial response measures completed at the Site include the following (refer to Figure 3):

- Excavation and off-site disposal of contaminated soil present within the FPA to address PCBs in soil.
- Soil vapor extraction (SVE) to treat a historic toluene pipeline spill in the Toluene Release Area (SWMU 11), located on the western side of the FPA, adjacent to Mill Street.

- Installation, operation, and maintenance of a groundwater extraction and treatment system to address elevated concentrations of Site compounds of concern (COC) in groundwater along the southeastern edge of the Site bordering the Pawtuxet River. The COC are listed in Tables 1& 2 on page 9 of this SOB.
- Excavation and off-site disposal, followed by capping, of contaminated soil/sediment present within the Pawtuxet River.

In 2009, BASF acquired the property and began verifying and further assessing the current environmental site conditions. The goal was to fully understand the IRMs and determine the need for additional remedial actions to complete the RCRA Corrective Action requirements and put the property back to productive use in the community. To this end, from 2011 to 2014, BASF conducted document review and field investigation tasks to validate IRM needs and effectiveness, and develop a proposed remediation plan. Investigation tasks included several rounds of soil, groundwater and sediment data collection and analysis. The results were documented in the SRI Report (AECOM 2014a).

For the FPA, the data provided only a refinement to the previous environmental impact characterization and no significant exposure concerns or environmental impacts were discovered. Regarding the OWLA, while no significant exposure concerns or environmental impacts were discovered, soil sampling along a former rail road spur that Ciba filled-in and a former parking lot showed sporadic impacts of residues that are typical of urban environments, called polycyclic aromatic hydrocarbons (PAH, e.g., residues from vehicle exhaust and runoff from paved surfaces) which, will be remediated.

From the BASF assessment, corrective measure options for the remediation of remaining soil and groundwater impacts were screened for feasibility in the CMS Work Plan (CMS WP, AECOM 2014b). Finally, in the CMS Report (AECOM 2016), the options were evaluated, and a proposed comprehensive plan to achieve RCRA Corrective Action site closure was developed. This SOB presents the components of the remedial actions that EPA and BASF believe are necessary to remediate the remaining contamination to current standards applicable to this site with consideration to its current and proposed future use.

As documented in the CMS (AECOM 2016), additional remedial response measures are proposed at the Site. Based on the information provided above and for presentation purposes the Site is separated into four sub-areas:

1. **The Former Production Area (FPA)** where all of the manufacturing operations occurred, where several areas of concern were identified, and where several IRMs were implemented to address groundwater and soil impacts (**Figures 2 and 3**).

Proposed soil remedy: excavation and off-site disposal of additional impacted soil present within the FPA to address remaining PCBs, VOCs and PAHs followed by the placement of a clean soil cover (cap) over the area. The soil cover will be constructed and maintained to support an ecologically varied open-space upland habitat. Land use constraints and a long-term maintenance and reporting plan will be implemented.

Proposed groundwater remedy: A combination of source material excavation, in-situ treatment and natural attenuation monitoring of impacted groundwater beneath the FPA.

2. **Pawtuxet River sediments Area** which were impacted by FPA waste discharges during facility operation and where IRMs were implemented to address sediment impacts (**Figure 3**).

Propose periodic monitoring of the existing sediment cap in the Pawtuxet River adjacent to the FPA to ensure that it is functioning as intended.

3. **Office/Warehouse/Laboratory Area (OWLA)** although not identified as an area of concern under the Corrective Action program, this area was evaluated in accordance with Rhode Island Department of Environmental Management (RIDEM) rules and regulations (**Figure 2**).

Propose soil excavation and/or capping of soils impacted by PAHs typical of urban use in the OWLA and place non-residential land use restrictions on the property to comply with RIDEM regulations.

4. **Former Waste Water Treatment Plant Area (FWWTA)**, which is located on a separate lot on Mayflower Drive (**Figure 1**), was identified as part of the Site by the EPA and was included in the comprehensive property remedial investigation. At the time of the 1995 remedial investigation, no significant environmental impacts were identified. The risk assessment indicated that there was no unacceptable risk for the current commercial/industrial use. Although Ciba sold the property in 2004, the property remains part of the RCRA Site because a final EPA determination was not issued.

Propose no additional remedial actions.

Environmental Evaluation

Former Production Area (FPA)

Site-specific, risk-based clean-up goals for soil, also known as Media Protection Standards (MPS), were developed for the FPA soil in the 1995 RFI Report (see AECOM 2014a). A Public Health and Environmental Risk Evaluation (PHERE) was performed at that time, and no unacceptable human or ecological health risk was found for soils. While this was the case at the time, the site-specific PCB MPS for FPA soil was set at 50 part per million (ppm) (or milligrams per kilogram [mg/kg]) based on consideration of a future outdoor worker for an industrial or commercial land-use scenario. The site-specific MPS is now compared to current Federal and State rules governing PCB cleanup. Specifically, under the Toxic Substance and Control Act (TSCA), 40 CFR 761.61(a) (4), the low occupancy¹ criteria is 50 ppm if the site is fenced and

¹ Low occupancy refers to areas where people do not spend significant amounts of time (e.g. unoccupied area outside a building)

marked. Alternately, removal of all PCBs in soil greater than 10 ppm and a cap over soil that contains greater than 1 ppm would allow a high occupancy Site re-use². The Rhode Island industrial/commercial direct exposure criteria (I/C DEC) for PCBs in soil include removal of all PCBs greater than 10 ppm and placement of a 2 foot soil cap. Therefore, the use of the 2 foot soil cap over soil with less than 10 ppm PCBs meets both Federal and State regulations, and it will result in a high occupancy Site re-use scenario including most urban and open space land uses.

For the FPA groundwater, the MPS were established based on standards that were protective of organisms living in the river sediment because groundwater in this area is classified by RIDEM as a non-potable resource (**GB classification**) and building within 200 feet of the Pawtuxet River is restricted as it is designated as a riverbank wetland.

The Site Media Protection Standards (MPS) for the FPA groundwater and soils are presented in **Table 1** and **Table 2**.

Table 1

Production Area – Groundwater [µg/L]		
VOCs	MPS	RIDEM GB Groundwater Objective
Toluene	1,700	1,700
2-Chlorotoluene	1,500	--
1,2-Dichlorobenzene	94	--
Chlorobenzene	1,700	3,200
Total xylenes	76	--

Notes:

- No GB Groundwater Objective exists

Table 2

Production Area – Soil [mg/kg]			
Compound	MPS	RIDEM Industrial / Commercial Direct Exposure Criterion	RIDEM GB Leachability Criteria
Total PCBs	50	10	10
Non-PCB COCs		As specified in the RIDEM Remediation Regulations	As specified in the RIDEM Remediation Regulations

Office/Warehouse/Laboratory Area (OWLA) Soil: At the time of the 1995 RFI, this area was not identified as an area of concern. During the BASF property reevaluation of soil and groundwater, only near-surface soil data showed sporadic exceedances of the applicable RIDEM I/C DEC for several PAHs. These PAHs are indicative of urban and industrial land use.

² High occupancy refers to areas where people spend significant time, 840 or more hours per year. This includes industrial and commercial use and open space use.

The property is currently zoned for industrial use except for the parking area (**see Figure 2**), which is zoned residential.

Former Waste Water Treatment Area (FWWTA)

At the time of the RFI in 1995, a risk assessment was conducted, and it was concluded that detected compounds identified as FWWTA compounds of potential concern (dieldrin, chlordane, bis (2-ethylhexyl phthalate), posed no unacceptable risk for an unrestricted future site use because the risk was within the USEPA target risk range of 1×10^{-4} and 1×10^{-6} and the total hazard index was less than 1.

This property is currently restricted/zoned as commercial for office or neighborhood business (Cranston, Rhode Island Code of Ordinances, which can be found at this internet address **www.municode.com/library/ri/cranston/codes/code_of_ordinances**). The data show that there are sporadic detections of two PAHs, a pesticide (chlordane) and arsenic in soil in excess of the current RIDEM I/C DEC. Except for chlordane which was utilized on-Site for pest control, these compounds were not considered site-related at the time of the RFI. These compounds were found within 200 feet of the Pawtuxet River at a depth of up to one foot below ground surface. Since construction is restricted in this area due to the 200 foot riverbank wetland setback, EPA believes exposure is limited. Therefore, for these reasons, the soil at the FWWTA property does not warrant further action.

Data from groundwater sampling performed at the FWWTA during the RFI was also evaluated in a risk assessment. The risk assessment concluded that compounds detected in groundwater posed no unacceptable risk for an unrestricted future site use. In addition, groundwater in this area is classified by RIDEM as a non-potable resource (**GB classification**) and the groundwater quality was consistent with the RIDEM GB criteria. Therefore, the groundwater at the FWWTA property does not warrant further action.

EPA's Proposed Remedial Actions

Although this is a Statement of Basis for a proposed remedial action, it is intended to result in a final administrative disposition of Corrective Action requirements for the Former Ciba-Geigy Facility Site. This is not an "unrestricted use" or "walk-away" determination. Future activities will include further remediation of impacted soil and groundwater and long-term maintenance and monitoring of the implemented remedial actions to verify that the remedial actions perform as intended and the remedy remains protective of human health and the environment.

BASF has accepted responsibility for implementation, operation, maintenance, and continued monitoring associated with these proposed efforts and will annually certify that sufficient financial assurance has been provided to complete the required actions. EPA believes that a final administrative disposition of "Corrective Action Complete with Controls" can be met upon completion of these remedial actions and implementation of the monitoring program.

A variety of clean-up methods that could be successfully implemented at the Site were evaluated to address the four areas requiring ongoing controls. The categories of cleanup

methods evaluated in determining the proper corrective actions, and whether a final determination was appropriate, included:

- 1) No action,
- 2) Environmental land use restriction,
- 3) Engineered controls,
- 4) Monitored natural attenuation,
- 5) In-place treatment, and
- 6) Above-ground removal, treatment/discharge/disposal.

Individual methods were evaluated for their ability to meet the corrective measures objectives including their ability to meet Media Protection Standards (MPS) which are site specific clean-up goals, the RIDEM Remediation Standards and the TSCA PCB standards.

Former Production Area (FPA) Groundwater: The remediation alternative for affected groundwater located within the FPA involves a three-step plan (refer to **Figure 4**).

First, residual VOC source material located in the upland area near SWMU 11 will be excavated from the unsaturated zone as part of the PCB remedy and disposed of offsite and any remaining VOC material will be destroyed in-situ with a chemical oxidant (activated sodium persulfate) by physically mixing the oxidant into the unsaturated and saturated zones before re-grading the area to support the soil cover.

Second, for the groundwater plume that has migrated to the vicinity of the river bulkhead, an in-situ reactive barrier utilizing ozone generated on-site will be installed parallel to the river bulkhead to a depth of over 30 feet below ground surface. The remaining groundwater plume will flow through this barrier to destroy VOC mass before it migrates off-site and discharges to the Pawtuxet River. The proposed oxidant is ozone gas, and it will be applied using a line of wells. It is estimated that this component of the remedy will be run for several years. The remedy design including the treatment volume, number and orientation of injection wells, and monitoring requirements will be determined during the pilot testing program. The ozone will destroy all VOC contamination in which it comes in contact, and it will also contribute oxygen to the groundwater to support aerobic biological degradation. Groundwater will be regularly monitored to determine when the up gradient and downgradient monitoring wells indicate that the MPS have been met. The system will be shut down when the MPS have been met. Monitoring will continue for several rounds after shutdown to determine whether there is a rebound in contaminant concentrations above the MPS. If there is no rebound then the system will be shut down and removed. The details will be included in the Operation and Maintenance plan (O&M) to be submitted at a later date.

Third, for dissolved upland VOC mass, monitored natural attenuation (MNA) will be used to show mass attenuation over time. These remedial measures used together are appropriate given the site-specific conditions which include extensive in-place building foundations which limits access to aquifer materials and low conductivity heterogeneous aquifer material coupled with the age of the impacts (greater than 40 years) which limits the mobility of the dissolved-phase mass. A RIDEM permit to conduct the in-situ remediation will be obtained. In conjunction

with, and following, active treatment, monitoring will continue to verify the effectiveness of the remedy, specifically, monitoring will assess spatial and temporal trends toward meeting the cleanup goals... The monitoring well network will be routinely analyzed until the remediation goals are met. All monitoring wells will be locked to prevent tampering within the Site which is fenced, locked, and patrolled. An Environmental Land Use Restriction (ELUR) will limit future land use to open-space and require long-term operation and maintenance. A restriction on the potable use of groundwater is already in place with the GB designation.

As part of this action, a contingent remedy would be implemented if groundwater monitoring results show that natural attenuation is not achieving the cleanup objective. This contingent remedy, if needed, would be submitted to EPA for review and approval before implementation.

Former Production Area (FPA) Soil: The goal associated with this remedy is to allow the entire FPA to be repurposed as open space. This will be achieved by removing soil containing PCBs greater than 10 ppm and installing a clean soil cover (cap) over the area, where the soil cover will be constructed and maintained to support an ecologically varied upland habitat.

The remedy will follow a three step plan consistent with both EPA and RIDEM requirements (refer to **Figures 5 and 6**): [1] Excavation, verification sampling and offsite disposal of all soil impacted with greater than 10 ppm of PCBs (i.e., the EPA requirement to allow for a high-occupancy reuse scenario); [2] Cover (i.e., cap) remaining soils with concentrations greater than 1 ppm with two feet of clean soil and confirmatory sampling to meet RIDEM direct exposure requirements. The cap will be completed to support a diverse upland habitat; [3] impose an ELUR on the parcel, to be approved by the RIDEM, requiring open space reuse only and long-term cap maintenance and monitoring. **Figure 6** shows a post-remedy conceptual design for potential development of the Site as open space. Details of the three step plan will be provided during the design-phase of the corrective action.

Pawtuxet River Sediment: Given the historic remedial measures completed for sediment at the Site, a long-term periodic monitoring program will be implemented to ensure the existing sand cap remains intact and protective. Monitoring frequency is initially proposed to occur at the first 5 year review (2021) and after major flood events between now and that time. A major flooding event is defined by the National Oceanic and Atmospheric Administration (NOAA) as a Pawtuxet River stage that exceeds 13 feet MSL at the US Geological Service (USGS) gage station 01116500). Under the monitoring plan the sand cap will be sampled for PCB content to ensure that any remaining PCBs sequestered below the cap are not permeating through the cap. If PCBs exceed 1 ppm in any sample, additional investigation will be conducted to determine the source of the detections and appropriate remedial measures necessary to ensure protectiveness, if any. A detailed monitoring and sampling plan will be developed following this outline. At the time of the 5 year review, based on the available data, a decision will be made, by EPA, as to the permanence of the remedy and any future monitoring requirements.

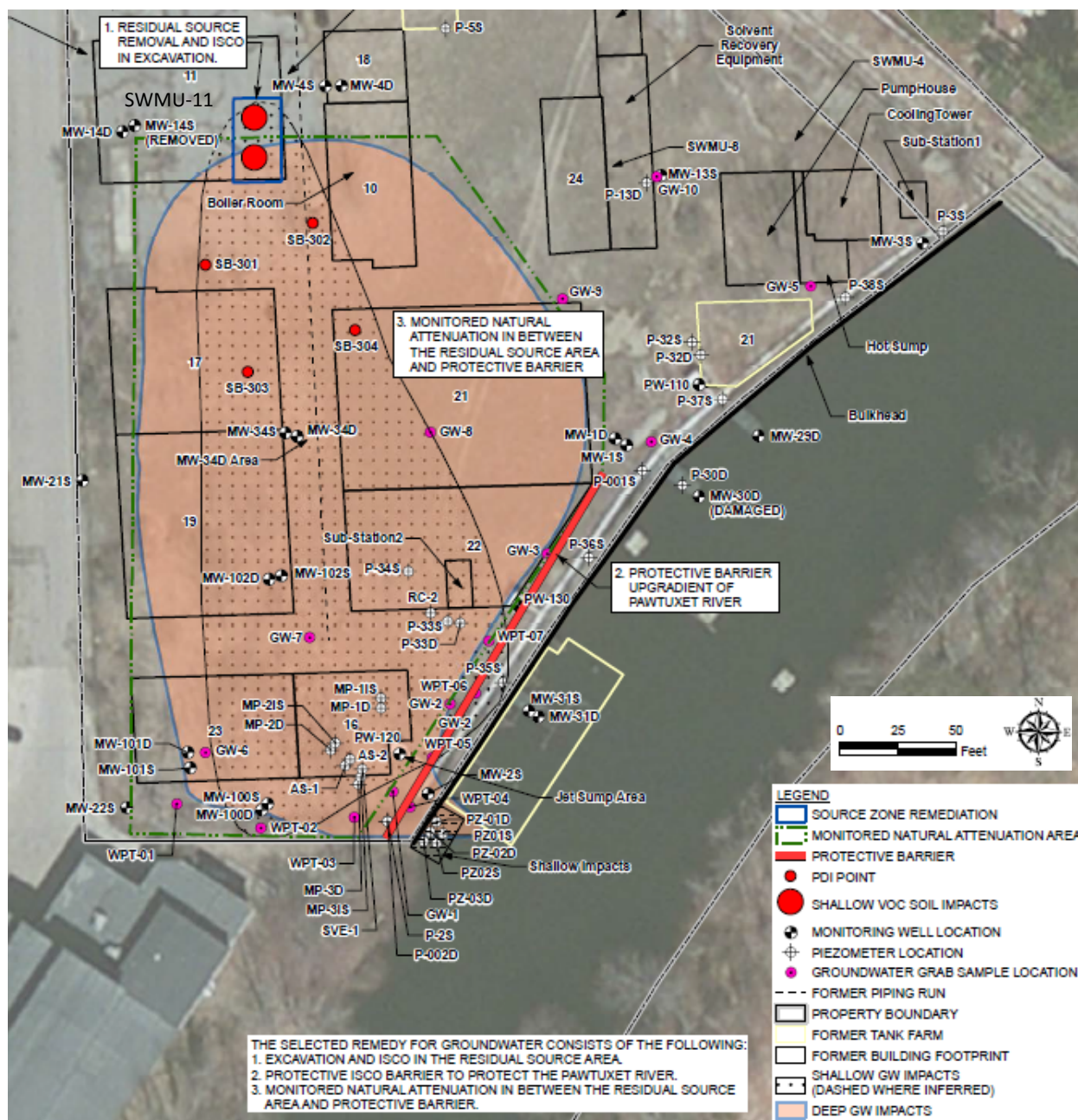


Figure 4 – Proposed groundwater remedy consists of 3 parts: source removal at SWMU-11, reactive barrier parallel to the river, and long-term monitored attenuation.

Office/Warehouse/Laboratory Area (OWLA) Soil: To address RIDEM Regulations, BASF will remove or cover the soil along the former rail spur and the parking area (refer to **Figure 2**) with exceedances of the RIDEM I/C DEC and impose an ELUR for this area to be approved by the RIDEM. The ELUR will include the following restrictions: non-residential use only, must employ

a soil management plan for any invasive work conducted on the property, and must, on an annual basis, report to the RIDEM that the terms of the ELUR are being met.

Former Waste Water Treatment Area (FWWTA) Soil: While the FWWTA exhibits sporadic exceedances of RIDEM I/C DEC for both naturally occurring and industry-related compounds, a risk assessment showed no unacceptable risk for a conservative reuse scenario of an on-site resident (despite commercial zoning). The 200 foot Riverbank Wetland setback prevents development and soil management without RIDEM approval. Thus, no further action is warranted at this time.

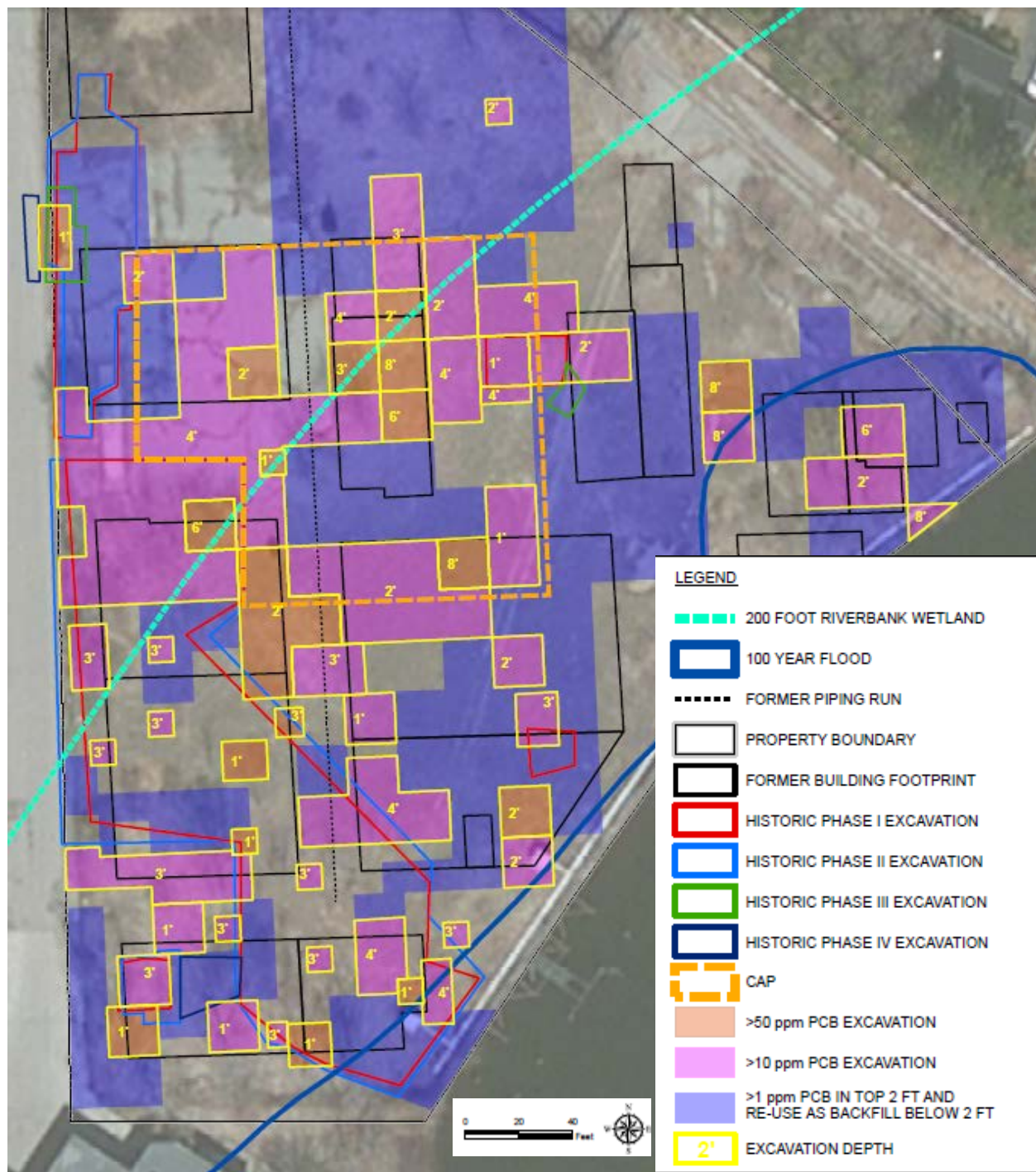


Figure 5 – FPA soil remedy, where color coding indicates areas of varying impact to be excavated.

contaminated materials identified in source areas, particularly in areas where there existed a high potential for the contaminated materials to migrate. Remedial measures were implemented in a phased manner where initial remedial measures focused on addressing the primary contaminant sources. The remedial response measures completed at the Site were described in the previous section titled “Summary of Completed Interim Remedial Measures”. The initial clean-up measures are being followed by completion of additional remedial response measures using more stringent soil standards in order to address residual sources that have the potential to pose a direct contact risk and impact groundwater using more stringent soil standards.

With EPA's final determination, BASF will complete additional soil excavation and off-Site disposal, in-situ groundwater treatment, and continued sediment and groundwater monitoring as long as it is shown to be required by monitoring data, establish ELURs, and inspect and maintain the cap associated with soils that do not need to be removed from the Site.

3. Site-specific media cleanup goals have been developed and will be met in all areas.

Although Interim cleanup objectives for soil in the FPA were met in the 1990s, updated TSCA and RIDEM remediation standards require that additional cleanup goals for soil and groundwater are necessary. Cleanup objectives for groundwater were also nearing targets as of 2008, when additional monitoring showed a recalcitrant zone not effectively addressed through the pumping and treatment IRM. BASF will remove and cap additional site soils to meet current Federal and State regulations. In addition, for groundwater a more targeted technology to address the residual groundwater impacts will be utilized to meet site-specific cleanup goals. For the areas where groundwater contamination currently remains above the MPS, a combination of excavation, in-situ chemical oxidation and monitored natural attenuation is proposed.

With approval of this remedy, soil and groundwater remediation will be implemented and ongoing operation, maintenance, and monitoring will follow to evaluate the remedy performance until cleanup goals are met.

Additionally, this remedy requires ongoing monitoring of the above discussed controls, and future land use for the property will be restricted to non-residential use through the establishment of an ELUR.

Evaluation of Remedy with Respect to Standards and Decision Factors

EPA believes that in addition to the rationale presented above, the appropriateness of a proposed remedy can be ascertained by evaluating the remedy using standardized Remedy Selection Criteria set forth in EPA guidance. This provides an additional level of objective review parameters for measuring the effectiveness of a proposed remedy. These Remedy Selection Criteria are presented below and were evaluated in the Corrective Measures Study (AECOM, 2016).

Threshold Criteria:Overall Protection of Human Health and the Environment:

The selected alternative is protective of human health and the environment. Excavation, disposal, and capping of soils are consistent with TSCA regulations and comply with the RIDEM Industrial/Commercial Direct Exposure Criteria (I/C DEC) and are considered appropriate for current and anticipated future non-residential land use under current zoning.

Proper handling of remediation reagents in groundwater will be utilized. In-situ remediation and monitored natural attenuation will degrade contaminants to less toxic and less mobile end-products which are protective of human health and the environment.

Attain Media Clean-up Standards:

The selected alternative will achieve Site-specific corrective action objectives for groundwater and soil. Excavation and off-site disposal and in-situ chemical oxidation will be targeted on-site to ultimately reduce groundwater concentrations at the downgradient property boundary to be protective of the Pawtuxet River. Monitoring will be implemented to verify effectiveness and attainment of the media cleanup standards.

Control Sources of Releases:

Sources of elevated PCB and VOC contamination will be either excavated and appropriately disposed, or treated in-situ, effectively eliminating the potential for residual PCB and VOC impacts to act as a continuing source to other media.

Compliance with Waste Management Standards:

The proposed remedy complies with all applicable requirements for the management of solid wastes including proper storage, transportation and disposal.

Balancing Criteria:Long-term Reliability and Effectiveness:

The soil remedy is effective and reliable in the long-term because contaminated soil will be removed from the Site and disposed of at a licensed landfill. Clean fill will be used to backfill the Site. The soil cap will be monitored to ensure that its integrity is not breached.

The groundwater remedy is effective and reliable with respect to the long-term because in-situ chemical oxidation and monitored natural attenuation will degrade the chemicals in groundwater. These are proven technologies and groundwater monitoring will be implemented to verify effectiveness.

Reduction of Toxicity, Mobility and Volume of Wastes:

The selected remedy for soil will reduce the toxicity, mobility and volume of wastes by removing them from the Site.

The selected remedy for groundwater will reduce the toxicity, mobility and volume of wastes. The contaminants will be transformed to non-toxic end products through chemical oxidation and natural attenuation.

Short-term Effectiveness:

This project, which includes soil remedy design, permitting, and contractor procurement is a standard civil engineering project that can be completed in an efficient and timely manner. The short-term impacts on the community will be limited by minimizing the amount of soil transported for off-site disposal. Once the remedy is implemented, it is effective in a short time due to the immediate removal of contaminated soil.

The groundwater remedy can be implemented in a reasonably short time-frame owing to the fact that it employs mature and common technology components (excavation, in-situ treatment using ozone injection and monitoring for natural attenuation). Pilot and then full-scale implementation of the in-situ component can be completed in an efficient and timely manner after applicable permits are obtained. Once the remedy is implemented, the proposed oxidant, ozone, works rapidly to destroy contamination in place.

Implementability:

Operations have ceased at the Site, thus, there are currently no existing conditions that would encumber implementation of the technologies. Each component of the proposed remedy (excavation, in-situ treatment and monitored attenuation) employs mature and common technologies. Therefore, this alternative is considered easily implemented.

The soil remedy meets all applicable Federal and State regulations while providing an enhanced upland habitat and open space land use. Thus, it has a favorable environmental footprint.

In-situ chemical oxidation for groundwater is an environmentally efficient method for restoring the groundwater resource relative to the former pumping and treatment IRM. In addition to the active remedy components, a monitoring plan will be implemented to characterize natural attenuation, where natural biological processes degrade contaminants and aid aquifer restoration. In addition, Operation and Maintenance (O&M) of the remedies are easily implemented as the remedies employ mature and common technologies.

Cost:

The cost-benefit relationship balances the total remedial costs with the likely future use. Considerable funds have already been expended and the additional cost for this soil remedy is consistent with the preferred open space end use for the FPA and will achieve the environmental benefit needed for that use. The in-situ chemical oxidation option for groundwater ranked most favorably for cost among the screened alternatives yet achieves the cleanup standards over time with immediate environmental benefit. Primary costs to implement the proposed remedies include capital costs (remedial design, bench-scale/pilot testing and injection point installation), reagent delivery costs, and remedial monitoring costs.

Federal, State and Community Acceptance

Excavating PCB-impacted soils and capping residual contaminants, excavating PAH-impacted soils, and excavating VOC-impacted soils are acceptable technologies to Federal and State agencies and adequately address risk to human health and the environment for future open

space re-use. Work will be conducted during normal business hours which should be acceptable to the local and surrounding communities.

In-situ groundwater remediation is acceptable to Federal and State regulators, and should be to the surrounding community, because it is a proven remedial technology that has been successfully implemented at similar sites in Rhode Island and across the United States. It requires little continuous activity and, except for minor truck traffic to deliver and install system infrastructure and supplies, is not expected to significantly disrupt the surrounding community since the system is contained on-site and this technology has the potential to restore the ground water quality in a timely manner.

Permits are required to complete the soil excavation and in-situ groundwater remedial action. Permits from the City of Cranston Planning and Zoning and RIDEM Wetlands department are needed to excavate within the 100-yr flood plain and the wetland buffer zone (200 feet from the Pawtuxet River bank). A RIDEM Groundwater Discharge Permit will need to be obtained to perform injections to the aquifer for the in-situ remediation for groundwater treatment. Approval is based on a completed application, compliance monitoring program, and regulatory notification of the remedial actions.

Finally, the EPA will consider any comments provided during the public notice comment period.

Conclusion

The proposed final remedy is sufficiently comprehensive in the short-term as there are no immediate risks to human health or the environment. In the long-term, EPA has determined that the historical on-Site releases of constituents to the soil and/or groundwater will be remediated to levels that are sufficiently protective and that sufficient protections for controlling any remaining risks, including ELURs have been incorporated herein. The toxicity, mobility, and volume of contaminants impacting the environment will be sufficiently reduced. The excavation of the most significantly impacted soil and decreases in groundwater contaminant concentrations as the result of in-situ remediation and natural attenuation is expected to reduce the overall toxicity, mobility, and amount of contamination remaining at the site in preparation for the proposed open space end use of the FPA.

Accordingly, EPA, using all available information, is recommending that these proposed remedial alternatives for the Former Ciba-Geigy Site be adopted. Specifically, investigations performed at the Site demonstrate that contaminant concentrations and distribution are well-defined and do not pose a threat to human health or the environment based on the current use of the site. Areas of the Site have either attained the Media Protection Standards or where the applicable standards have not been attained, the proposed remediation and monitoring or protective controls will achieve the cleanup standards. The FPA is zoned as an industrial property and its reuse as open space with enhanced upland habitat is protective of human health and the environment.

GLOSSARY

Administrative Record – Collection of documents (reports, correspondence, etc.) that form the basis for the remedy selection.

Areas of Concern (AOCs) – Areas of a site that may be contaminated as a result of previous Site operational activities, so they are targeted for investigation and follow-up.

Ciba-Geigy Corporation – A company that operated the Facility at 180 Mill Street, Cranston, RI, for many years and was purchased by BASF Corporation in 2009.

Compound of Concern (COC) – A chemical related to Site operations that has been detected at elevated concentrations and is targeted for removal or destruction.

Corrective Measures Study (CMS) – A report that evaluates alternatives for cleanup of RCRA contaminated sites and may include a summary of previous investigations, interim remedial measures and media protection standards.

Environmental Land Use Restriction (ELUR) – An ELUR is recorded on the title to the property and will ensure that the property or restricted portion of a property is not used for any residential activity in the future and that any future use of the property or restricted portion is limited to industrial/commercial activity. Broadly, the purpose of an ELUR is to minimize the risk of human exposure to pollutants and hazards to the environment by preventing specific uses or activities at a property and is binding on all owners and successors.

EPA – United States Environmental Protection Agency

Former Ciba-Geigy Site – The former manufacturing Site located at 180 Mill Street in Cranston, Rhode Island. Owned by Alrose Chemical Company and then transferred through company acquisitions to the current owner (since 2009), BASF Corporation.

FPA – Former Production Area was the on-site area on Mill Street where manufacturing occurred.

FWWTA – Former Waste Water Treatment Area that Ciba-Geigy operated on Mayflower Avenue.

I/C DEC – Industrial/Commercial Direct Exposure Criteria under the RIDEM Remediation Regulations for governing what levels of compounds may safely stay in the environment if future land use is for industrial or commercial operations.

Interim Remedial Measures (IRM) – Actions taken prior to a final remedy decision to protect human health and the environment by controlling the spread or release of contaminants to the environment.

Media Protection Standards (MPS) – Screening values used during the CMS to evaluate the potential effectiveness of a technology or alternative to address site conditions. These values

were developed using a risk assessment approved by EPA and are protective of human health and the environment under current site use.

NOAA – National Oceanic and Atmospheric Administration

OWLA – Office/Warehouse/Laboratory Area in the northern part of the Site.

PCBs – Polychlorinated biphenyls

PAH - polycyclic aromatic hydrocarbon

Resource Conservation and Recovery Act (RCRA) – This law regulates the management and disposal of hazardous wastes.

RCRA - Resource Conservation and Recovery Act

RCRA Facility Assessment (RFA) – An EPA assessment of a RCRA Site to determine if releases to any environmental media have occurred.

RCRA Facility Investigation (RFI) – Investigation to determine the nature and extent of contamination at a facility.

RI – Remediation Investigation where soil, groundwater, and sometimes surface water or sediment samples are collected and analyzed to determine if they contain any Site COCs.

RIDEM – Rhode Island Department of Environmental Management

Risk Assessment – Formal process to evaluate the hazards presented by environmental conditions at the Site.

Solid Waste Management Unit (SWMU) – Area of a property where solid waste, as defined by RCRA, is managed.

Statement of Basis – Document presenting the proposed remedy for a facility to the public. The Statement of Basis provides a brief summary of the facility conditions, potential risks, and alternatives studied in the detailed analysis phase of the CMS.

SVOC – Semi-volatile organic compounds

TSCA - Toxic Substance and Control Act (TSCA), 40 CFR 761, regulations that deal with PCBs in the environment.

VOC – Volatile organic compounds

REFERENCES

AECOM. Supplemental Remedial Investigation. 2012, rev., 2014a.

AECOM, Corrective Measures Study Work Plan, 2014b.

AECOM, Corrective Measures Study. 2016.



ATTACHMENT B

Ozone Basics and MSDS

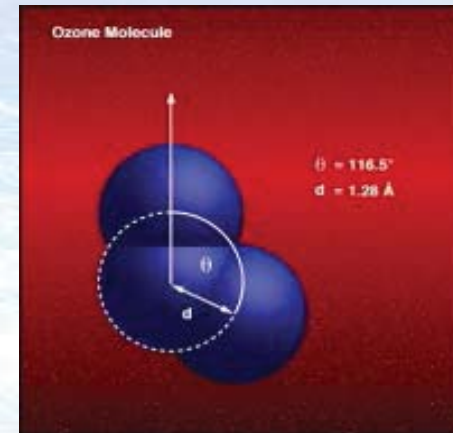
The background of the slide features a dramatic landscape with a bright, jagged lightning bolt striking down from the top left corner. The sky is a deep, dark blue, while the lower portion shows a vibrant green field. The overall composition is dynamic and visually striking.

Basics Of Ozone

What is Ozone?

What is Ozone?

- Triatomic Oxygen – O_3
- Highly reactive
 - Strong chemical oxidant
- Unstable
 - Readily decomposes to oxygen
 - Decomposition accelerates with increasing temperature and pressure
- Light blue gas, colorless at ambient conditions
- Distinct odor



Ozone Properties

Name	Ozone	Oxygen
Molecular Formula	O ₃	O ₂
Molecular Weight	48 g/mol	32 g/mol
Color	Light blue	Colorless
Smell	-Electric motors -Smell after lightening	Odorless
Melting point	-192.5 ° C	-218.79 ° C
Boiling point	-111.9 ° C	-182.95 ° C
Critical Temperature	-12.1° C	-118.56 ° C
Critical Pressure	54.5 atm	5.043 atm
Density	2.144 g/l @ 0 ° C	1.429 g/l @ 0 ° C
Solubility @ 0-deg C	0.64 g/100ml	0.049 g/100ml
Electrochemical Potential	2.07 V	1.23 V

Ozone Solubility

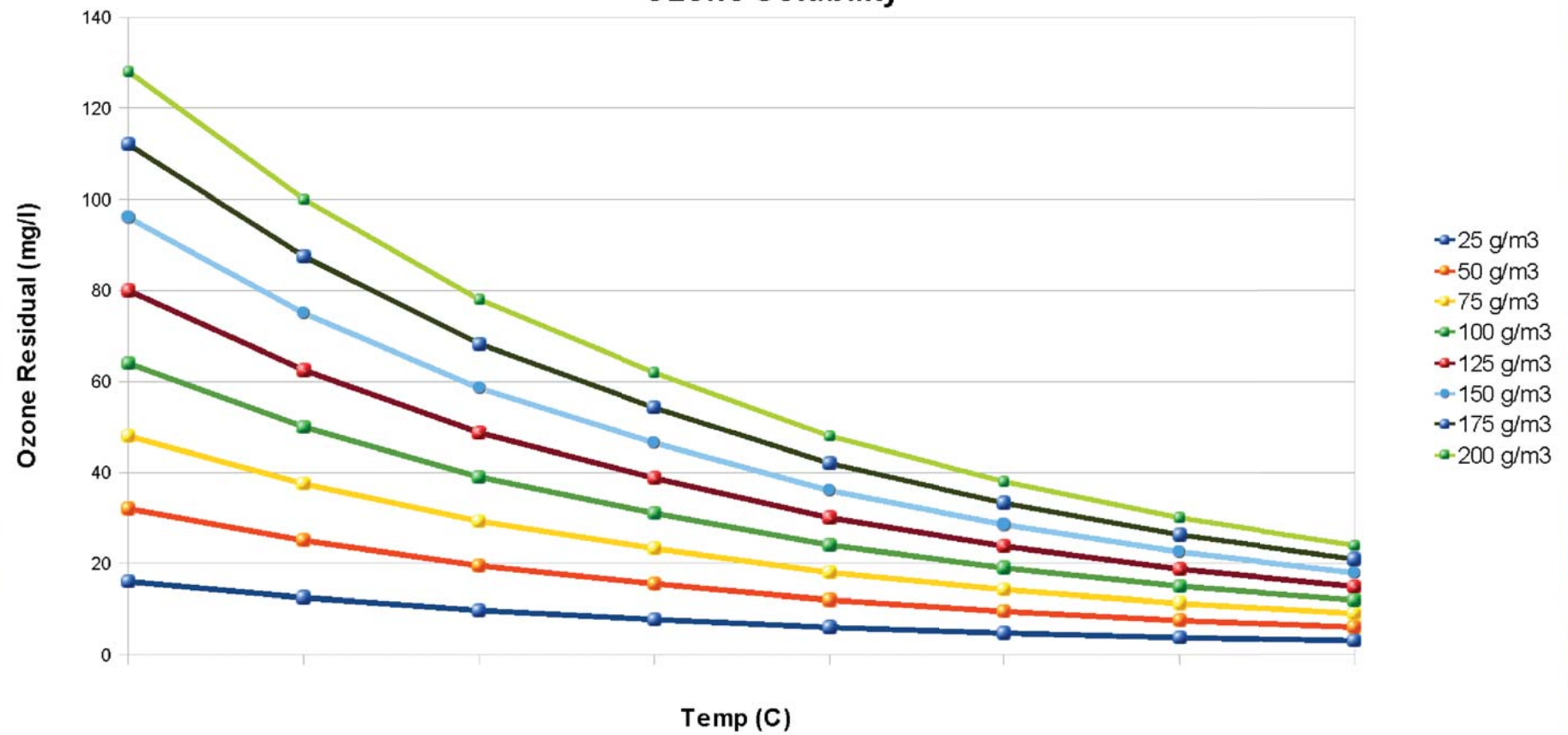
The solubility of ozone is temperature dependent. The concentration of ozone will also increase the solubility of ozone into water. The table below displays the saturation point of ozone into water in PPM or mg/l

Water Temperature

	0° C	5° C	10° C	15° C	20° C	25° C	30° C	35° C
25 g/m³	16	12.5	9.75	7.75	6	4.75	3.75	3
50 g/m³	32	25	19.5	15.5	12	9.5	7.5	6
75 g/m³	48	37.5	29.25	23.25	18	14.25	11.25	9
100 g/m³	64	50	39	31	24	19	15	12
125 g/m³	80	62.5	48.75	38.75	30	23.75	18.75	15
150 g/m³	96	75	58.5	46.5	36	28.5	22.5	18.75
175 g/m³	112	87.5	68.25	45.25	42	33.25	26.25	21
200 g/m³	128	100	78	62	48	38	30	24

O₃ Gas

Ozone Solubility



Typical O₃ Half Life

Gaseous Ozone

Temp (C)	Half-life
-50	3 months
-35	18 days
-25	8 days
20	3 days
120	1.5 hours
250	1.5 seconds

Ozone Dissolved in Water (ph-7)

Temp (C)	Half-life
15	30 minutes
20	20 minutes
25	15 minutes
30	12 minutes
35	8 minutes

Half-life values are based on thermal decomposition only. No organic loading or other catalytic effects are considered.

Oxidation potential

Oxidant	Electrochemical Potential (volts)
Free Radical, -OH	2.80
Ozone, O ₃	2.07
Hydrogen Peroxide, H ₂ O ₂	1.78
Potassium Permanganate, KMnO ₄	1.70
Chlorine Dioxide, ClO ₂	1.57
Hypochlorous Acid, HOCl	1.49
Chlorine gas, Cl ₂	1.36
Oxygen (molecular), O ₂	1.23
Bromine	1.09
Sodium Hypochlorite, NaOCl	0.94
Iodine	0.54

Consequences of O₃ Properties

- **Instability**
 - Short half-life; Must generate ozone on site
- **Partially Soluble Gas**
 - Requires mechanical gas/liquid contacting
- **Strong Oxidant**
 - Material compatibility can cause problems
- **Detection – difficult to monitor**
 - Ozone breaks down upon contact with sensor cell
- **Safety**
 - Short-term health hazards with ambient ozone

Advantages of Ozone

- Strongest disinfectant available
- Strongest oxidizing agent available
- Is environmentally friendly
- Adds no chemicals (no chemical storage)
- Unstable - Leaves no residual (only oxygen)
- Allows ozone-advanced oxidation OH-
- Can lower overall operating costs

Disadvantages of Ozone

- Unstable – must produce as needed
- Gas-liquid contacting equipment is required
- Generation/contacting can be complex, difficult to control
- Impurities can form undesired by-products
- System must be designed with personnel safety in mind

SAFETY DATA SHEET for OZONE

(Formerly MSDS)

1. PRODUCT IDENTIFICATION

Product Name: Ozone**Common Names/Synonyms:** Triatomic Oxygen, Trioxygen, O₃**Ozone Generator Manufacturer/Supplier**

Ozone Solutions, Inc.

website: www.ozonesolutions.com

451 Black Forest Rd.

email: tech@ozonesolutions.com

Hull, IA 51239

712-439-6880

Product Use: This SDS is limited to ozone produced in gaseous form on site by an ozone generator, in varying concentrations in either air or aqueous solution, for the purposes of odor abatement, oxidation of organic compounds, or antimicrobial intervention, in a variety of applications, from food processing to ground water remediation.

2. HAZARD IDENTIFICATION



GHS Classifications:

Physical Hazards	Health Hazards	Environmental Hazards
Oxidizing Gas	Skin Irritation – Category 3	Acute Aquatic Toxicity – Category I
	Eye Irritation – Category 2B	
	Respiratory Systemic Toxicity – Category 1 (Acute & Repeated Exposures)	

NOTE: Severe respiratory toxicity will develop before skin or eye irritation go beyond listed categories. *Anyone with chronic pulmonary problems, especially asthma, should avoid exposure to ozone.*

WHMIS Classifications (Workplace Hazardous Materials Information System, Canada)

D1A	Acute lethality – Very toxic, immediately	C	Oxidizing
D2A	Chronic Toxicity – Very Toxic	F	Dangerously Reactive
D2B	Mutagenicity – Toxic		

3. COMPOSITION

Chemical name Ozone

Common names Triatomic oxygen, trioxygen

Chemical Formula O₃

CAS Registry Number 10028-15-6

4. FIRST AID MEASURES

Route of Entry		Symptoms	First Aid
Skin Contact	YES	Irritation	Rinse with water
Skin Absorption	NO	NA	NA
Eye Contact	YES	Irritation	Rinse with water, remove contacts
Ingestion	NO	NA	NA
Inhalation	YES	Headache, cough, dry throat, heavy chest, shortness of breath	Remove to fresh air, provide oxygen therapy as needed

For severe cases, or when symptoms don't improve, seek medical help.

5. FIRE FIGHTING MEASURES

While ozone itself is not flammable, it is a strong oxidant and may accelerate, even initiate, combustion, or cause explosions. Use whatever extinguishing agents are indicated for burning materials.

6. ACCIDENTAL RELEASE MEASURES

Turn off ozone generator, and ventilate the area. Evacuate the area until ozone levels subside.

7. HANDLING AND STORAGE

Ozone must be contained within ozone-resistant tubing and pipes from the generation point to the application point. Any leaks must be repaired before further use.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

OSHA Permissible Exposure Limit: 8 hour Time Weighted Average **0.1 ppm**

ANSI/ASTM: 8 hour TWA **0.1 ppm**, Short Term Exposure Limit **0.3 ppm**

ACGIH: 8 hour TWA **0.1 ppm**; STEL **0.3 ppm**

NIOSH: Exposure Limit Ceiling Value **0.1 ppm** light; **0.08 ppm** moderate; **0.05 ppm**, heavy;

Light, moderate, heavy work TWA \leq 2 hours, **.2 ppm**

Immediately Dangerous to Life or Health **5 ppm**

Respiratory Protection: Use full face self-contained breathing apparatus for entering areas with high concentration of ozone.

Engineering controls: use ozone destruct units (thermal and/or catalytic) for off gassing ozone.

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical state	Gas	pH	NA
Molecular Weight	48.0	Flash point	NA
Appearance	Clear at low concentrations, blue at higher concentrations	Evaporation rate	NA
Odor	Distinctive pungent odor	Flammability	NA
Odor threshold	0.02 to 0.05 ppm; exposure desensitizes	Explosive limits	NA

Melting point	-193°C/-315°F	Relative density	NA
Boiling point	-112°C/-169°F	Partition coefficient	NA
Vapor pressure	> 1 atm	Auto-ignition temperature	NA
Vapor density	1.6 (air = 1)	Decomposition temperature	NA
Solubility in water	570 mg/L @20°C, 100% O ₃ ; 0.64 @0°C (vol/vol)	Viscosity	NA

10. STABILITY AND REACTIVITY

Ozone is highly unstable and highly reactive. Avoid contact with oxidizable substances, including alkenes, benzene and other aromatic compounds, rubber, dicyanogen, bromine diethyl ether, dinitrogen tetroxide, nitrogen trichloride, hydrogen bromide, and tetrafluorohydrazine. Ozone will readily react and spontaneously decompose under normal ambient temperatures.

11. TOXICOLOGICAL INFORMATION

Likely routes of exposure: inhalation, eyes, skin exposure.

Effects of Acute Exposure: Discomfort, including headache, coughing, dry throat, shortness of breath, heavy feeling in chest (including possible pulmonary edema/fluid in the lungs); higher levels of exposure intensify symptoms. Irritation of skin and/or eyes is also possible.

Effects of Chronic Exposure: Similar to acute exposure effects, with possible development of chronic breathing disorders, including asthma.

Inhalation LC₅₀: mice, 12.6 ppm for 3 hours; hamsters, 35.5 ppm for 3 hours

Irritancy of Ozone	YES
Sensitization to Ozone	NO
Carcinogenicity (NTP, IARC, OSHA)	NO
Reproductive Toxicity	Not Proven
Teratogenicity	Not Proven
Mutagenicity	Not Proven
Toxicologically Synergistic Products	Increase susceptibility to allergens, pathogens, irritants

12. ECOLOGICAL INFORMATION

The immediate surrounding area may be adversely affected by an ozone release, particularly plant life. Discharge of ozone in water solution would also be harmful to any aquatic life. Due to natural decomposition, bioaccumulation will not occur, and the area affected would be limited.

13. DISPOSAL CONSIDERATIONS

Off-gassing of ozone should be through an ozone destruct unit which uses heat and/or a catalyst to accomplish the breakdown of ozone to oxygen before release into the atmosphere.

14. TRANSPORT INFORMATION

NOT APPLICABLE, as ozone is unstable and either reacts with other substances in the environment or decomposes, and therefore must be generated at the location and time of use.

15. REGULATORY INFORMATION

SARA = Superfund Amendments and Renewal Act

SARA Title III Section 302 Extremely Hazardous Substance TPQ: 100 lbs.

SARA Title III Section 304, EHS RQ: 100 lbs.

SARA Title III Section 313: Ozone is reportable if more than 10,000 lbs. are used/year.

TPQ (Threshold Planning Quantity) requires emergency planning activities if this amount is on site at any time during year

RQ (Reportable Quantity) requires any release of this amount into the environment to be reported to the National Response Center

Source: EPA List of Lists

16. OTHER INFORMATION

The half-life of ozone is much shorter in water than in air. Increased temperature in either solvent decreases the half-life. Published research indicates a half-life of 20 minutes for ozone dissolved in water at 20°C, and a half-life of approximately 25 hours for ozone in dry air at 24°C (McClurkin & Maier, 2010). The practical half-life time is actually less, especially in air, due to air circulation, humidity, the presence of contaminants or walls with which to react, etc. In many situations, with air movement, warmer temperatures, and normal relative humidity, the half-life of ozone in air could be 1 hour or less. Further, ventilation of a closed space to other areas will also disperse the ozone, so that concentration levels can rapidly decrease after generation ceases.

Source websites:

Canadian Centre for Occupational Health and Safety: Chemical Profiles: Ozone

http://www.ccohs.ca/oshanswers/chemicals/chem_profiles/ozone/

Haz-Map: Occupational Exposure to Hazardous Agents: Ozone

http://hazmap.nlm.nih.gov/cgi-bin/hazmap_generic?tbl=TblAgents&id=68

International Chemical Safety Cards #0068: Ozone

<http://www.cdc.gov/niosh/ipcsneng/neng0068.html>

NIOSH Pocket Guide to Chemical Hazards: Ozone <http://www.cdc.gov/niosh/npg/npgd0476.html>

United States National Library of Medicine ChemIDplus Lite: Ozone 10028-15-6

<http://chem.sis.nlm.nih.gov/chemidplus/ProxyServlet?objectHandle=DBMaint&actionHandle=default&nextPage=jsp/chemidlite/ResultScreen.jsp&TXTSUPERLISTID=0010028156>

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Date of Preparation: 5/1/2012

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ATTACHMENT C

Excerpts From AECOM's Supplemental Investigation Report

4.0 Results

4.1 Overview

The objectives for this Supplemental RI were to:

- Close data gaps that were not addressed during previous investigations at the Site,
- Update the contaminant concentration dataset at locations where historical data may not be representative of current conditions (i.e., data 10 years old or greater),
- Revise the CSM for soil and groundwater impacts, and
- Provide additional data upon which to conduct an FFS to address remaining soil and groundwater impacts.

This section presents the results of the characterization relative to the objectives.

4.2 Groundwater Results

4.2.1 Groundwater Flow

Synoptic rounds of groundwater elevations were collected on June 11, 2012 and November 6, 2012. The data are tabulated in Table 4-1. The groundwater potentiometric maps for shallow and deep groundwater (Figures 2-5A, 2-5B, 2-6A, and 2-6B) present the horizontal groundwater flow direction at the Site. The data for June and November 2012 were comparable. Groundwater flow direction across the Site is to the southeast, toward the Pawtuxet River. Figure 2-7 shows a hydrogeological interpretation in cross-sectional view, where groundwater flows toward and discharges to the river. The figures show that a bulkhead wall is present along the northern bank of the River, orthogonal to groundwater flow direction, to an estimated depth of 25 ft bgs. Groundwater extraction wells, PW-110, PW-120, PW-130, are located along the river, on the north side of the bulkhead wall and are not currently operational.

4.2.2 Volatile Organic Compounds (VOCs)

Groundwater quality samples were collected from existing monitoring wells, extraction wells and Geoprobe locations. The data are tabulated in Table 4-2. Figures 4-1 through 4-10 provide an interpretation of the current groundwater impacts for chlorobenzene, 1,2-dichlorobenzene, 2-chlorotoluene, toluene, and total xylenes. The vertical distribution is shown through cross-sections presented in Figures 4-11 through 4-14.

The focus of the groundwater sampling was to obtain a snapshot of VOC concentrations throughout the Production Area. Specifically, the goal of the groundwater characterization was to identify VOC concentrations in excess of the MPS and use that information to select locations for VOC sampling of soil to evaluate for potential remaining recalcitrant source zones. A secondary goal of the investigation was to rule out any potential sources of contamination that had been identified as data gaps.

A total of 51 groundwater samples were collected from 28 monitoring wells, 3 extraction wells, and 10 temporary groundwater grab locations (GW-series), for VOC analysis. The data were compared to

the MPS. Results are presented in Table 4-2. There were 10 groundwater samples where one or more MPS were exceeded in groundwater.

In the southern third of the Production Area, in the area of Building 19 and Building 21, south to the Site property boundary and east to the Pawtuxet River, five groundwater grab samples and five monitoring well samples exceeded the MPS for various Site COCs.

Chlorobenzene: Groundwater grab samples GW-6 (19-21 ft bgs), GW-7 (19-21 ft bgs), GW-7 (24-26 ft bgs), GW-8 (19-21 ft bgs), and monitoring wells P-35S (screened at 10' to 15' BGS), MW-100D (20-25 ft bgs), MW-101D (20-25 ft bgs) and MW-102D (20-25 ft bgs) contained chlorobenzene concentrations in groundwater that exceeded the MPS. Of note, the chlorobenzene concentrations at GW-7 (19-21 ft bgs), GW-8 (19-21 ft bgs), P-35S, MW-101D, and MW-102D all exceeded 1% of the solubility of chlorobenzene. This suggests that these locations, or locations immediately upgradient, may contain isolated, recalcitrant source material. However, the screened intervals with these exceedances are situated in low permeability soils; therefore, the flux of chlorobenzene in groundwater is likely low, skewing the concentrations to be elevated in the absence of faster moving groundwater mixing with the COC diffusing out of the low permeability matrix. Figures 4-1 and 4-6 present the chlorobenzene plume in deep and shallow groundwater, respectively, in plan view. Figure 4-11 presents the chlorobenzene plume in groundwater in cross-section A-A'. Concentrations in groundwater that exceed the MPS are presented. The concentrations of chlorobenzene in soil above 1 mg/kg are included on the plan view figures to view the relationship between elevated soil and elevated groundwater concentrations.

1,2-Dichlorobenzene: GW-1 (26-28 ft bgs), GW-1 (31-33 ft bgs), and GW-6 (19-21 ft bgs) contained concentrations that exceeded the 1,2-dichlorobenzene MPS. Figures 4-2 and 4-7 present the 1,2-dichlorobenzene plume in deep and shallow groundwater, respectively. Concentrations in groundwater that exceed the MPS are presented. The concentrations of 1,2-dichlorobenzene above 1 mg/kg are included on the figures to view the relationship between elevated soil and elevated groundwater concentrations. Figure 4-2 shows 1,2-DCB discharging to the river sediments above the MPS, however, additional groundwater quality data beneath the river (past the bulkhead) may show that levels attenuate before discharge to the river.

2-Chlorotoluene: GW-7 (19-21 ft bgs) and MW-102D contained 2-chlorotoluene concentrations that exceeded the MPS. Figures 4-3 and 4-8 present the 2-chlorotoluene plume in deep and shallow groundwater, respectively, in plan view. Figure 4-12 presents the 2-chlorotoluene plume in groundwater in cross-section A-A'. Concentrations in groundwater that exceed the MPS are presented. The concentrations of 2-chlorotoluene in soil above 1 mg/kg are included on the figures to view the relationship between elevated soil and elevated groundwater concentrations.

Toluene: GW-7 (19-21 ft bgs), GW-8 (19-21 ft bgs) and MW-102D contained toluene concentrations that exceeded the MPS. Note that the toluene concentration in groundwater at MW-102D exceeded 1% of toluene solubility which suggests that a source area containing recalcitrant toluene may be upgradient of MW-102D. However, the screened interval for this exceedance is situated in low permeability soils; therefore, the flux of toluene in groundwater is likely low, skewing the concentrations to be elevated in the absence of faster moving groundwater mixing with the COC diffusing out of the low permeability matrix. Figures 4-4 and 4-9 present the toluene plume in deep and shallow groundwater, respectively, in plan view. Figure 4-13 presents the toluene plume in groundwater in cross-section A-A'. Concentrations in groundwater that exceed the MPS are presented. The concentrations of toluene in soil above 1 mg/kg are included on the figures to view the relationship between elevated soil and elevated groundwater concentrations.

Total Xylenes: MW-102D and MW-34S contained total xylene concentrations that exceeded the MPS. Figures 4-5 and 4-10 present the total xylene plume in deep and shallow groundwater, respectively, in plan view. Figure 4-14 presents the xylenes plume in groundwater in cross section A-A'. Concentrations in groundwater that exceed the MPS are presented. The concentrations of total xylenes in soil above 1 mg/kg are included on the figures to view the relationship between elevated soil and elevated groundwater concentrations.

4.3 Soil Results

Soil samples were collected to both characterize ongoing sources for groundwater impacts above the MPS (i.e., VOC impacts above and below the water table) and to characterize remaining shallow soil impacts that have the potential to cause ongoing direct contact risk exposures (i.e., PCB impacts above the water table).

With respect to VOCs, the following existing data were used to identify data gaps:

1. Previous RI data and remedial action documentation;
2. Long-term time trends at existing monitoring and pumping wells;
3. MIP study results from 2007 and the related soil and groundwater concentrations from that study were used to establish a soil and groundwater monitoring program that would target areas of impact for investigation; and
4. AS/SVE pilot test was completed in the summer of 2011. Monitoring points that were installed to monitor the test and to monitor groundwater outside the area of impact (MW-100S/D, MW_101S/D, and MW-102S/D) indicated that area of contamination was larger than was assumed by relying on the 2007 MIP data.

As presented in the sections above, groundwater monitoring was completed to identify areas in soil beneath the water table that should be targeted for soil sampling during the Supplemental RI. A second MIP study was planned for the Supplemental RI to follow the groundwater monitoring event such that the soil boring depth intervals to be sampled and their location could be pinpointed. The groundwater analytical data and field observations were used to locate nine additional soil samples (SB-127 [deep], SB-130 through SB-137), as described below, that were submitted for VOC analysis. These data were used to identify soil boring locations and VOC sample depths to fill data gaps and provide data to be used in a focused feasibility evaluation of remedial alternatives.

With regard to shallow soil PCB delineation, Figure 3-3 shows the area associated with previous remedial action (Section 3.3.2). From the current study soil borings SB-101 through SB-129 (0-2 ft bgs) were advanced to confirm the results of the Revised On-Site IRM Report (Woodward-Clyde, 1996), fill data gaps from the historical data evaluation, and provide data upon which a risk-based closure can be derived. Figure 3-3 presents a color-dot map relating to the PCB concentrations in IRM confirmatory (CF-series) and 2012 (SB-series) PCB soil samples.

Completion of the planned investigation was accomplished by using an iterative dynamic approach to the investigation, incorporating field screening techniques, field-based decision-making and real-time evaluation of data to modify the sampling plan. Figure 3-2 presents the actual soil boring locations which may differ from the plan presented in the May 2012 Workplan due to the dynamic approach and localized areas of refusal due to the presence of concrete pilings, foundations, etc.

Table 4-1 - Groundwater Elevation Data
Former CIBA-GEIGY Facility
180 Mill Street, Cranston RI



Sampling location ID	Northing (1)	Easting (1)	Elevation (1)			GW gauging information							Data elevation and location source	Data collection date	GW elevation
			Top of Casing	Top of Inside Pipe	Ground	DTW (2)	DTB (2)	Screen length (3)	Screen interval detph (3)	Well Diameter (in)	Comments	Measuring point			6/12/2012
MW-4D	249046.28	352085.59	19.79	19.67	17.35	9.47	44.42	10	38-48	4	Soft bottom	Inside pipe	DiPrete Engineering	6/12/2012	10.20
MW-4S	249046.19	352078.31	21.31	20.70	17.79	10.42	20.67	10	6-16	4		Inside pipe	DiPrete Engineering	6/12/2012	10.28
MW-14D	249025.97	351990.68	20.74	20.51	18.28	10.12	51.21	10	37-47	4		Inside pipe	DiPrete Engineering	6/12/2012	10.39
MW-34S	248895.17	352061.44	18.20	18.02	15.51	8.27	20.40	10	9.5-19.5	4		Inside pipe	DiPrete Engineering	6/12/2012	9.75
MW-34D	248893.89	352066.69	18.55	18.16	15.70	9.17	48.40	10	38-48	4		Inside pipe	DiPrete Engineering	6/12/2012	8.99
MW-102S	248833.65	352060.36	16.97	16.85	14.88	7.60	15.93	10	5-15	2		Inside pipe	DiPrete Engineering	6/12/2012	9.25
MW-102D	248831.97	352054.80	17.28	17.09	15.14	8.52	25.40	5	20-25	2		Inside pipe	DiPrete Engineering	6/12/2012	8.57
P-36S	248841.10	352192.74	15.23	15.01	12.63	7.85	17.71	5	10.59-15.59	2	Transducer in well	Inside pipe	DiPrete Engineering	6/12/2012	7.16
P30-D	248872.66	352233.98	16.14	15.57	n/a	8.81	49.9	3	35-38	1	In river; Replacement for MW-30D	Inside pipe	DiPrete Engineering	6/12/2012	6.76
MW-1D	248892.46	352204.07	15.55	15.40	13.23	8.04	52.55	10	38-48	4		Inside pipe	DiPrete Engineering	6/12/2012	7.36
MW-1S	248890.04	352209.46	15.76	14.65	12.88	9.75	17.51	10	3-13	4		Inside pipe	DiPrete Engineering	6/12/2012	4.90
MW-29D	248893.43	352266.22	15.60	15.44	n/a	9.75	44.55	10	34-44	2	In river	Inside pipe	DiPrete Engineering	6/12/2012	5.69
P-37S	248909.52	352250.92	14.82	14.63	12.67	7.15	17.51	5	9.71-14.71	2		Inside pipe	DiPrete Engineering	6/12/2012	7.48
MW-13S	249006.79	352224.10	17.79	17.55	15.08	8.45	18.37	10	4.75-14.75	4	Soft bottom	Inside pipe	DiPrete Engineering	6/12/2012	9.10
P-13D	249004.07	352217.92	17.92	17.97	15.24	8.87	40.02	3	35-38	1	Inside pipe higher than casing	Inside pipe	DiPrete Engineering	6/12/2012	9.10
P-38S	248953.74	352304.29	14.91	14.75	12.48	7.15	17.98	5	10.73-15.73	2		Inside pipe	DiPrete Engineering	6/12/2012	7.60
MW-12D	249122.43	352149.05	21.02	20.34	18.79	9.90	47.63	10	33.5-43.5	4	No lock	Inside pipe	DiPrete Engineering	6/12/2012	10.44
MW-12S	249127.85	352147.17	22.28	21.66	18.93	11.35	20.79	10	6-16	4		Inside pipe	DiPrete Engineering	6/12/2012	10.31
MW-10S	249171.35	352085.90	22.89	21.74	19.75	12.32	23.63	10	8-18	4	Transducer in well; ground = concrete	Casing	DiPrete Engineering	6/12/2012	10.57
MW-10D	249172.08	352089.52	22.93	20.74	19.77	12.32	49.68	10	33.5-43.5	4	Transducer in well; ground = concrete	Casing	DiPrete Engineering	6/12/2012	10.61
PW-110	248915.84	352240.39	15.22	15.68	13.63	7.99	23.61	15	15-30	6	Pump in well; Inside pipe higher than casing	Inside pipe	DiPrete Engineering	6/12/2012	7.69
PW-130	248820.01	352161.83	15.27	15.73	13.74	8.46	40.76	10	7-17; 28-38	6	Pump in well	Inside pipe	DiPrete Engineering	6/12/2012	7.27
MW-31D	248771.88	352170.89	15.59	15.32	n/a	8.57	45.33	10	36-46	2	Soft bottom; in river	Inside pipe	DiPrete Engineering	6/12/2012	6.75
PW-120	248755.29	352110.93	14.24	15.14	13.05	7.47	35.20	5; 10	10-15; 30-40	6	Pump in well; Inside pipe higher than casing	Inside pipe	DiPrete Engineering	6/12/2012	7.67
MW-21S	248874.04	351973.60	15.12	14.70	14.90	5.10	10.44	10	6-16	4	Broken road box, no plug	Inside pipe	DiPrete Engineering	6/12/2012	9.60
MW-100S	248734.17	352054.14	15.26	15.09	12.86	6.35	15.00	10	5-15	2	Soft bottom; ground - concrete	Inside pipe	DiPrete Engineering	6/12/2012	8.74
MW-100D	248731.04	352051.50	15.05	14.84	12.85	6.92	24.70	5	20-25	2	Ground = concrete	Inside pipe	DiPrete Engineering	6/12/2012	7.92
MW-101S	248749.48	352020.51	16.00	15.82	13.59	6.89	15.83	10	5-15	2	Ground = concrete	Inside pipe	DiPrete Engineering	6/12/2012	8.93
MW-101D	248757.01	352019.50	15.77	15.61	13.55	7.35	24.80	5	20-25	2		Inside pipe	DiPrete Engineering	6/12/2012	8.26
MW-22S	248732.50	351992.51	16.63	16.04	13.29	7.30	20.30	10	5-15	4	Poison ivy	Inside pipe	DiPrete Engineering	6/12/2012	8.74
MW-2S	248738.82	352123.11	15.00	13.69	11.71	7.62	18.75	10	8-18	4		Casing	DiPrete Engineering	6/12/2012	7.38
P-35S	248786.65	352155.59	14.75	14.45	12.29	7.37	17.25	5	9.98-14.98	2	Labeled MW-102B	Inside pipe	DiPrete Engineering	6/12/2012	7.08
MW-20S	249162.25	351972.17	21.62	21.09	18.18	10.31	20.69	10	6-16	4		Inside pipe	DiPrete Engineering	6/12/2012	10.78

Notes:

- 1 Data collected by DiPrete Engineering on June 12, 2012
Horizontal Datum: RI STATE PLANE (NAD-83), US SURVEY FEET
Vertical Datum: NAVD'88, US SURVEY FEET
- 2 Relative depth from measuring point.
- 3 Relative depth from ground surface.

Table 4-2 Groundwater Analytical Data
Former Ciba-Geigy Facility
180 Mill Street, Cranston, RI
June 2012

		lab_sdg	% Solubility	Media Protection Standards	1206229 GW1	1206239 GW1	1206229 GW2	1206229 GW2	1206229 GW3	1206229 GW3	1206229 GW4	1206229 GW4	1206229 GW4	1206229 GW5	1206229 GW5	1206239 GW5	1206239 GW6	1206239 GW7	1206239 GW7	1206239 GW8	1206239 GW8
		sys_loc_code sys_sample_code sample_date			W1 26-28 061312 6/13/2012	W1 31-33 061412 6/14/2012	W2 26-28 061312 6/13/2012	W2 31-33 061312 6/13/2012	W3 26-28 061312 6/13/2012	W3 31-33 061312 6/13/2012	W4 26-28 061312 6/13/2012	W4 26-28 061312 6/13/2012	W4 31-33 061312 6/13/2012	W5 23-27 061312 6/13/2012	W5 30-32 061312 6/13/2012	W5 19-21 061412 6/14/2012	W6 24-26 061412 6/14/2012	W7 19-21 061412 6/14/2012	W7 24-26 061412 6/14/2012	W8 19-21 061412 6/14/2012	W8 24-26 061412 6/14/2012
analytic_method	cas_rn	chemical_name	report_result_unit																		
SW8260B	71-55-6	1,1,1-TRICHLOROETHANE (TCA)	mg/l	NA	NA	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U
SW8260B	79-34-5	1,1,2,2-TETRACHLOROETHANE	mg/l	NA	NA	< 0.0005 U	< 0.0005 U	< 0.0005 U	< 0.0005 U	< 0.0005 U	< 0.0005 U	< 0.0005 U	< 0.0005 U	< 0.0005 U	< 0.0005 U	< 0.0005 U	< 0.0005 U	< 0.0005 U	< 0.0005 U	< 0.0005 U	< 0.0005 U
SW8260B	76-13-1	1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE	mg/l	NA	NA	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U
SW8260B	79-00-5	1,1,2-TRICHLOROETHANE	mg/l	NA	NA	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U
SW8260B	75-34-3	1,1-DICHLOROETHANE	mg/l	NA	NA	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U
SW8260B	75-35-4	1,1-DICHLOROETHENE	mg/l	NA	NA	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U
SW8260B	87-61-6	1,2,3-TRICHLOROBENZENE	mg/l	NA	NA	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U
SW8260B	120-82-1	1,2,4-TRICHLOROBENZENE	mg/l	NA	NA	0.0021	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U
SW8260B	96-12-8	1,2-DIBROMO-3-CHLOROPROPANE (DBCP)	mg/l	NA	NA	< 0.0050 U	< 0.0050 U	< 0.0050 U	< 0.0050 U	< 0.0050 U	< 0.0050 U	< 0.0050 U	< 0.0050 U	< 0.0050 U	< 0.0050 U	< 0.0050 U	< 0.0050 U	< 0.0050 U	< 0.0050 U	< 0.0050 U	< 0.0050 U
SW8260B	106-93-4	1,2-DIBROMOETHANE (EDB)	mg/l	NA	NA	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U
SW8260B	95-50-1	1,2-DICHLOROENZENE	mg/l	1.37	0.094	0.756 D	0.407 D	< 0.0010 U	0.0082	0.0019	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	0.146 D	0.0292	0.0149	0.0035	0.0979	0.0014
SW8260B	107-06-2	1,2-DICHLOROETHANE	mg/l	NA	NA	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	0.0024	0.0061	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U
SW8260B	78-87-5	1,2-DICHLOROPROPANE	mg/l	NA	NA	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U
SW8260B	541-73-1	1,3-DICHLOROBENZENE	mg/l	NA	NA	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U
SW8260B	106-46-7	1,4-DICHLOROBENZENE	mg/l	NA	NA	0.0061	0.0022	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	0.0053	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U
SW8260B	123-91-1	1,4-Dioxane	mg/l	NA	NA	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U
SW8260B	78-93-3	2-BUTANONE (MEK)	mg/l	NA	NA	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U
SW8260B	95-49-8	2-CHLOROTOLUENE	mg/l	NA	1.5	0.0034	< 0.0010 U	< 0.0010 U	0.0121	0.125	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	0.288 D	< 0.0010 U	8.92 D	0.198 D	1.23 D	0.0082
SW8260B	591-78-6	2-HEXANONE	mg/l	NA	NA	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U
SW8260B	108-10-1	4-METHYL-2-PENTANONE (MIBK)	mg/l	NA	NA	< 0.0250 U	< 0.0250 U	< 0.0250 U	< 0.0250 U	< 0.0250 U	< 0.0250 U	< 0.0250 U	< 0.0250 U	< 0.0250 U	< 0.0250 U	< 0.0250 U	< 0.0250 U	< 0.0250 U	< 0.0250 U	< 0.0250 U	< 0.0250 U
SW8260B	67-64-1	ACETONE	mg/l	NA	NA	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U
SW8260B	71-43-2	BENZENE	mg/l	NA	NA	0.0062	< 0.0010 U	< 0.0010 U	0.0021	0.0065	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	0.0253	0.600 D	0.411 D	0.870 D	0.0318
SW8260B	75-27-4	BROMODICHLOROMETHANE	mg/l	NA	NA	< 0.0006 U	< 0.0006 U	< 0.0006 U	< 0.0006 U	< 0.0006 U	< 0.0006 U	< 0.0006 U	< 0.0006 U	< 0.0006 U	< 0.0006 U	< 0.0006 U	< 0.0006 U	< 0.0006 U	< 0.0006 U	< 0.0006 U	< 0.0006 U
SW8260B	75-25-2	BROMOFORM	mg/l	NA	NA	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U
SW8260B	74-83-9	BROMOMETHANE	mg/l	NA	NA	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U
SW8260B	75-15-0	CARBON DISULFIDE	mg/l	NA	NA	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	0.0021	0.0012	0.0014	0.0010	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U
SW8260B	56-23-5	CARBON TETRACHLORIDE	mg/l	NA	NA	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U
SW8260B	108-90-7	CHLOROBENZENE	mg/l	4.66	1.7	0.162 D	0.0300	0.0043	0.0435	0.0117	0.0037	0.0370	0.0377	0.0141	< 0.0010 U	0.0027	2.58 D	1.56 D	6.37 D	2.53 D	9.93 D
SW8260B	74-97-5	CHLOROBROMOMETHANE	mg/l	NA	NA	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U
SW8260B	75-00-3	CHLOROETHANE	mg/l	NA	NA	0.0032	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U
SW8260B	67-66-3	CHLOROFORM	mg/l	NA	NA	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U
SW8260B	74-87-3	CHLOROMETHANE	mg/l	NA	NA	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U
SW8260B	156-59-2	CIS-1,2-DICHLOROETHENE	mg/l	NA	NA	0.0028	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	0.0011	< 0.0010 U	0.0012
SW8260B	10061-01-5	CIS-1,3-DICHLOROPROPENE	mg/l	NA	NA	< 0.0004 U	< 0.0004 U	< 0.0004 U	< 0.0004 U	< 0.0004 U	< 0.0004 U	< 0.0004 U	< 0.0004 U	< 0.0004 U	< 0.0004 U	< 0.0004 U	< 0.0004 U	< 0.0004 U	< 0.0004 U	< 0.0004 U	< 0.0004 U
SW8260B	110-82-7	CYCLOHEXANE	mg/l	NA	NA	< 0.0050 U	< 0.0050 U	< 0.0050 U	< 0.0050 U	< 0.0050 U	< 0.0050 U	< 0.0050 U	< 0.0050 U	< 0.0050 U	< 0.0050 U	< 0.0050 U	< 0.0050 U	< 0.0050 U	< 0.0050 U	< 0.0050 U	< 0.0050 U
SW8260B	124-48-1	DIBROMOCHLOROMETHANE	mg/l	NA	NA	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U
SW8260B	75-71-8	DICHLORODIFLUOROMETHANE	mg/l	NA	NA	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U
SW8260B	100-41-4	ETHYLBENZENE	mg/l	NA	NA	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	0.0012	< 0.0010 U	0.113 D	0.0563	0.209 D	< 0.0010 U
SW8260B	98-82-8	ISOPROPYLBENZENE	mg/l	NA	NA	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U												

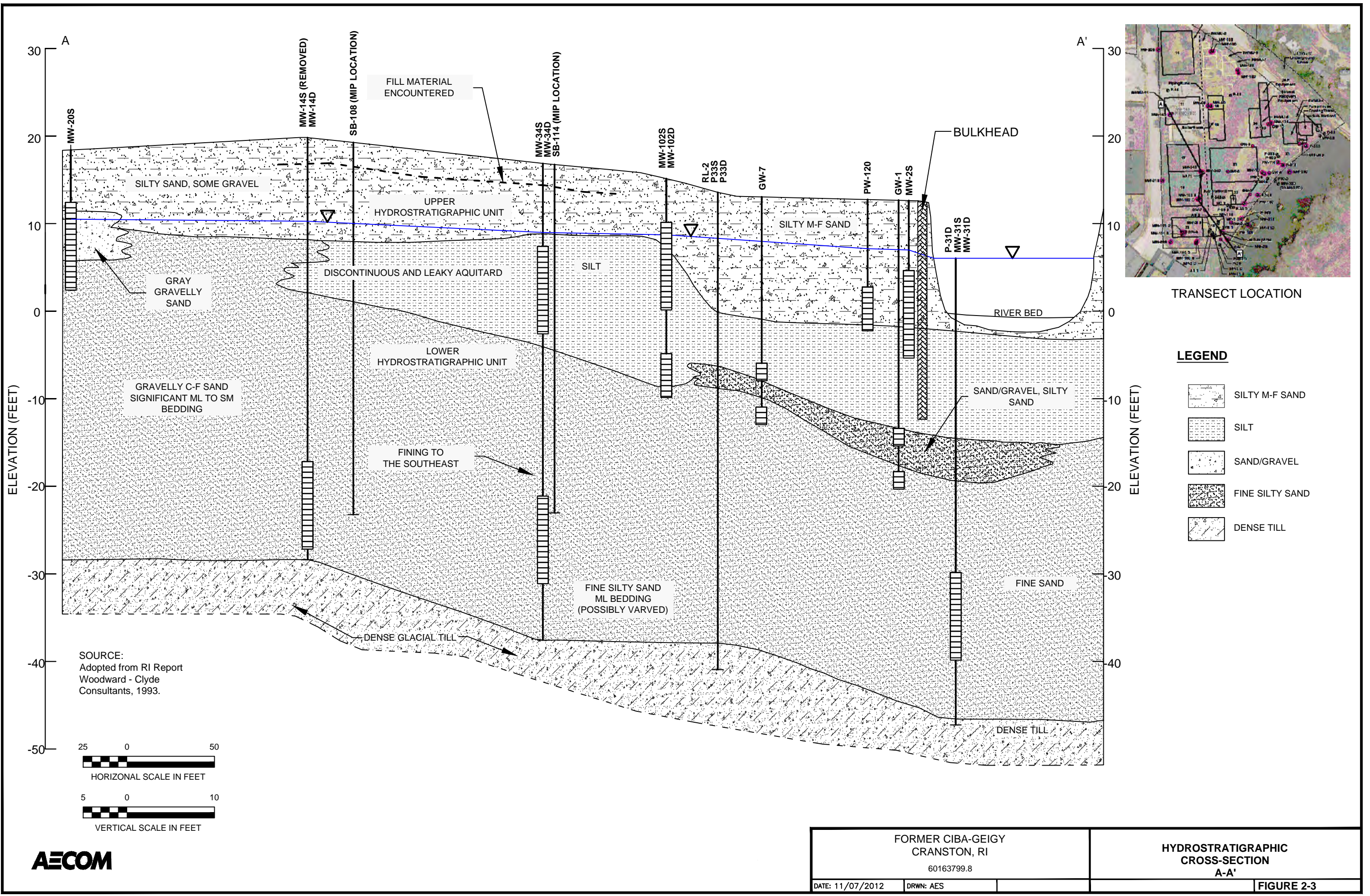
**Table 4-2 Groundwater Analytical Data
Former Ciba-Geigy Facility
180 Mill Street, Cranston, RI
June 2012**

[illegible]

**Table 4-2 Groundwater Analytical Data
Former Ciba-Geigy Facility
180 Mill Street, Cranston, RI
June 2012**

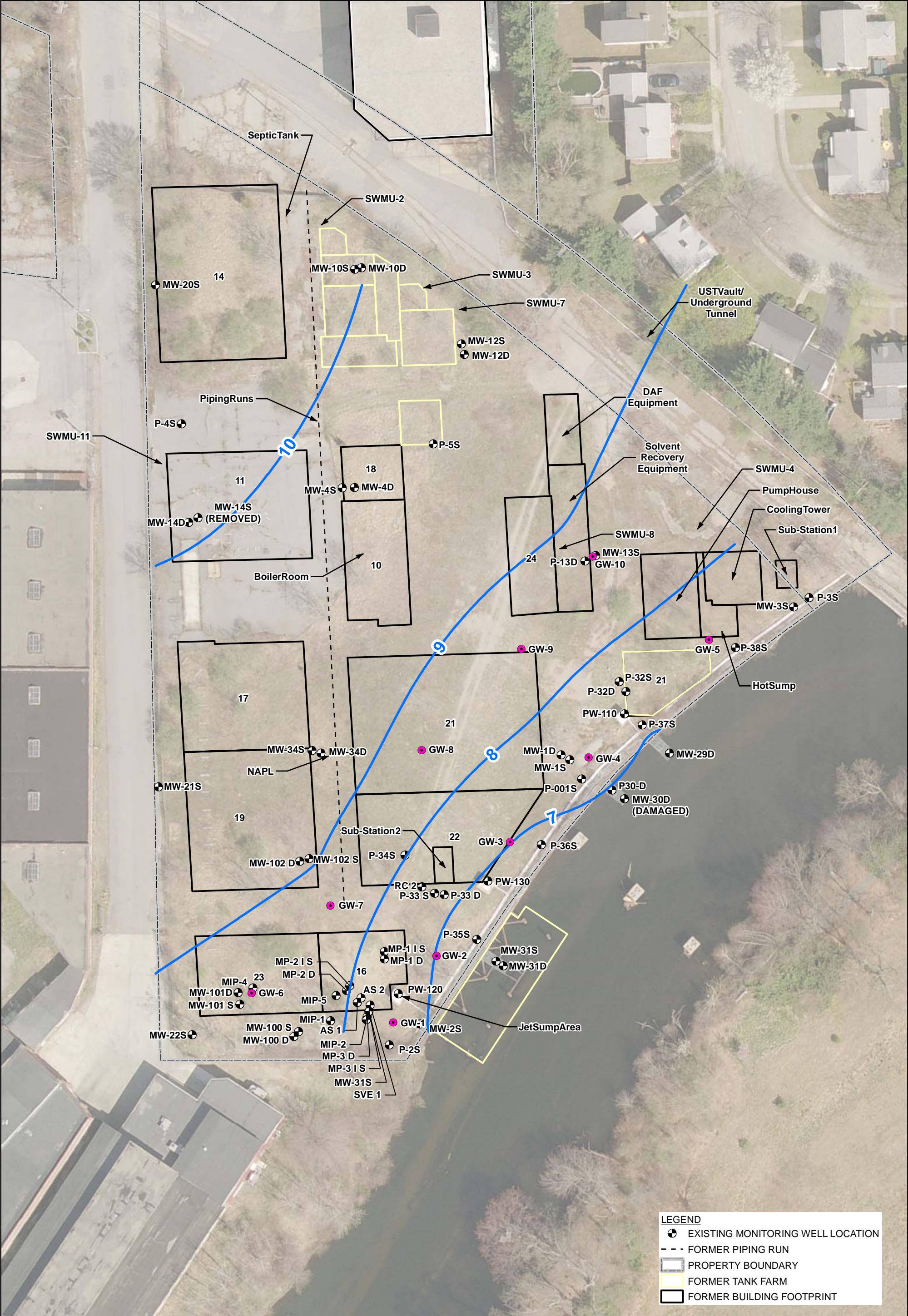
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		sys_loc_code	MW-001S	MW-002S	MW-029D	MW-031D	1206230	1206230	1206230	1206230	1206230	1206230	1206230	1206230	1206230	1206238	1206238	1206238	1206238	1206238	1206238	
		sys_sample_code	MW-15-061312-1	MW-25-061312-1	MW-29D-061312-1	MW-31D-061312-1	P-355-061312-1	P-365-061312-1	P-375-061312-1	P-385-061312-1	PW-110-061312-1	PW-120-061312-1	PW-130-061312-1	PW-130-061312-1	PW-130-061312-1	MW-013S	MW-021S	MW-022S	MW-000	MW-100S	MW-101D	MW-101S
		sample_date	6/13/2012	6/13/2012	6/13/2012	6/13/2012	6/13/2012	6/13/2012	6/13/2012	6/13/2012	6/13/2012	6/13/2012	6/13/2012	6/13/2012	6/13/2012	6/14/2012	6/14/2012	6/14/2012	6/14/2012	6/14/2012	6/14/2012	6/14/2012
analytic_method	cas_rn	chemical_name	report_result	unit																		
SW8260B	71-55-6	1,1,1-TRICHLOROETHANE (TCA)	mg/l	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U
SW8260B	79-34-5	1,1,2,2-TETRACHLOROETHANE	mg/l	< 0.0005 U	< 0.0005 U	< 0.0005 U	< 0.0005 U	< 0.0005 U	< 0.0005 U	< 0.0005 U	< 0.0005 U	< 0.0005 U	< 0.0005 U	< 0.0005 U	< 0.0005 U	< 0.0005 U	< 0.0005 U	< 0.0005 U	< 0.0005 U	< 0.0005 U	< 0.0005 U	< 0.0005 U
SW8260B	76-13-1	1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE	mg/l	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U
SW8260B	79-00-5	1,1,2-TRICHLOROETHANE	mg/l	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U
SW8260B	75-34-3	1,1-DICHLOROETHANE	mg/l	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U
SW8260B	75-35-4	1,1-DICHLOROETHENE	mg/l	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U
SW8260B	87-61-6	1,2,3-TRICHLOROBENZENE	mg/l	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U
SW8260B	120-82-1	1,2,4-TRICHLOROBENZENE	mg/l	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U
SW8260B	96-12-8	1,2-DIBROMO-3-CHLOROPROPANE (DBCP)	mg/l	< 0.0050 U	< 0.0050 U	< 0.0050 U	< 0.0050 U	< 0.0050 U	< 0.0050 U	< 0.0050 U	< 0.0050 U	< 0.0050 U	< 0.0050 U	< 0.0050 U	< 0.0050 U	< 0.0050 U	< 0.0050 U	< 0.0050 U	< 0.0050 U	< 0.0050 U	< 0.0050 U	< 0.0050 U
SW8260B	106-93-4	1,2-DIBROMOETHANE (EDB)	mg/l	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U
SW8260B	95-50-1	1,2-DICHLOROBENZENE	mg/l	< 0.0010 U	< 0.0010 U	< 0.0010 U	0.0125	0.0215	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U
SW8260B	107-06-2	1,2-DICHLOROETHANE	mg/l	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U
SW8260B	78-87-5	1,2-DICHLOROPROPANE	mg/l	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U
SW8260B	541-73-1	1,3-DICHLOROBENZENE	mg/l	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U
SW8260B	106-46-7	1,4-DICHLOROBENZENE	mg/l	< 0.0010 U	< 0.0010 U	< 0.0010 U	0.0017	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U
SW8260B	123-91-1	1,4-Dioxane	mg/l	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U	< 0.500 U
SW8260B	78-93-3	2-BUTANONE (MEK)	mg/l	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U
SW8260B	95-49-8	2-CHLOROTOLUENE	mg/l	< 0.0062	< 0.0010 U	< 0.0010 U	0.0429	0.111 D	< 0.0010 U	< 0.0010 U	< 0.0010 U	0.0026	0.0056	0.0015	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U
SW8260B	591-78-6	2-HEXANONE	mg/l	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U
SW8260B	108-10-1	4-METHYL-2-PENTANONE (MIBK)	mg/l	< 0.0250 U	< 0.0250 U	< 0.0250 U	< 0.0250 U	< 0.0250 U	< 0.0250 U	< 0.0250 U	< 0.0250 U	< 0.0250 U	< 0.0250 U	< 0.0250 U	< 0.0250 U	< 0.0250 U	< 0.0250 U	< 0.0250 U	< 0.0250 U	< 0.0250 U	< 0.0250 U	< 0.0250 U
SW8260B	67-64-1	ACETONE	mg/l	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U	< 0.0100 U
SW8260B	71-43-2	BENZENE	mg/l	0.0044	< 0.0010 U	< 0.0010 U	0.0104	0.454 D	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	0.0102	0.0029	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U
SW8260B	75-27-4	BROMODICHLOROMETHANE	mg/l	< 0.0006 U	< 0.0006 U	< 0.0006 U	< 0.0006 U	< 0.0006 U	< 0.0006 U	< 0.0006 U	< 0.0006 U	< 0.0006 U	< 0.0006 U	< 0.0006 U	< 0.0006 U	< 0.0006 U	< 0.0006 U	< 0.0006 U	< 0.0006 U	< 0.0006 U	< 0.0006 U	< 0.0006 U
SW8260B	75-25-2	BROMOFORM	mg/l	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U
SW8260B	74-83-9	BROMOMETHANE	mg/l	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U
SW8260B	75-15-0	CARBON DISULFIDE	mg/l	< 0.0010 U	< 0.0010 U	< 0.0010 U	0.0027	0.0018	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U
SW8260B	56-23-5	CARBON TETRACHLORIDE	mg/l	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U
SW8260B	108-90-7	CHLOROBENZENE	mg/l	0.785 D	< 0.0010 U	< 0.0010 U	0.0925	7.16 D	< 0.0010 U	< 0.0010 U	< 0.0010 U	0.0012	0.296 D	0.133 D	0.134 D	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U
SW8260B	74-97-5	CHLOROBROMOMETHANE	mg/l	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U
SW8260B	75-00-3	CHLOROETHANE	mg/l	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U
SW8260B	67-66-3	CHLOROFORM	mg/l	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U
SW8260B	74-87-3	CHLOROMETHANE	mg/l	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U	< 0.0020 U
SW8260B	156-59-2	CIS-1,2-DICHLOROETHENE	mg/l	< 0.0010 U	< 0.0010 U	< 0.0010 U	0.0026	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	0.0170	0.0012	0.0012	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U	< 0.0010 U
SW8260B	10061-01-5	CIS-1,3-DICHLOROPROPENE	mg/l	< 0.0004 U	< 0.0004 U	< 0.0004 U	< 0.0004 U	< 0.0004 U	< 0.0004 U	< 0.0004 U	< 0.0004 U	< 0.0004 U	< 0.0004 U	< 0.0004 U	< 0.0004 U	< 0.0004 U	<					

File: c:\indl\Service\Project_Files\BASF-0760\Cransston_RI\7_Deliverables\1_GIS_Database\CA002\SRP_Report\HYDROSTRATIGRAPHY_CROSS_SECTIONS.dwg Layout: FIGURE 2-3 User: sanchez01 Plotted: Nov 16, 2012 - 11:10am Xref's:



DRWN: AES



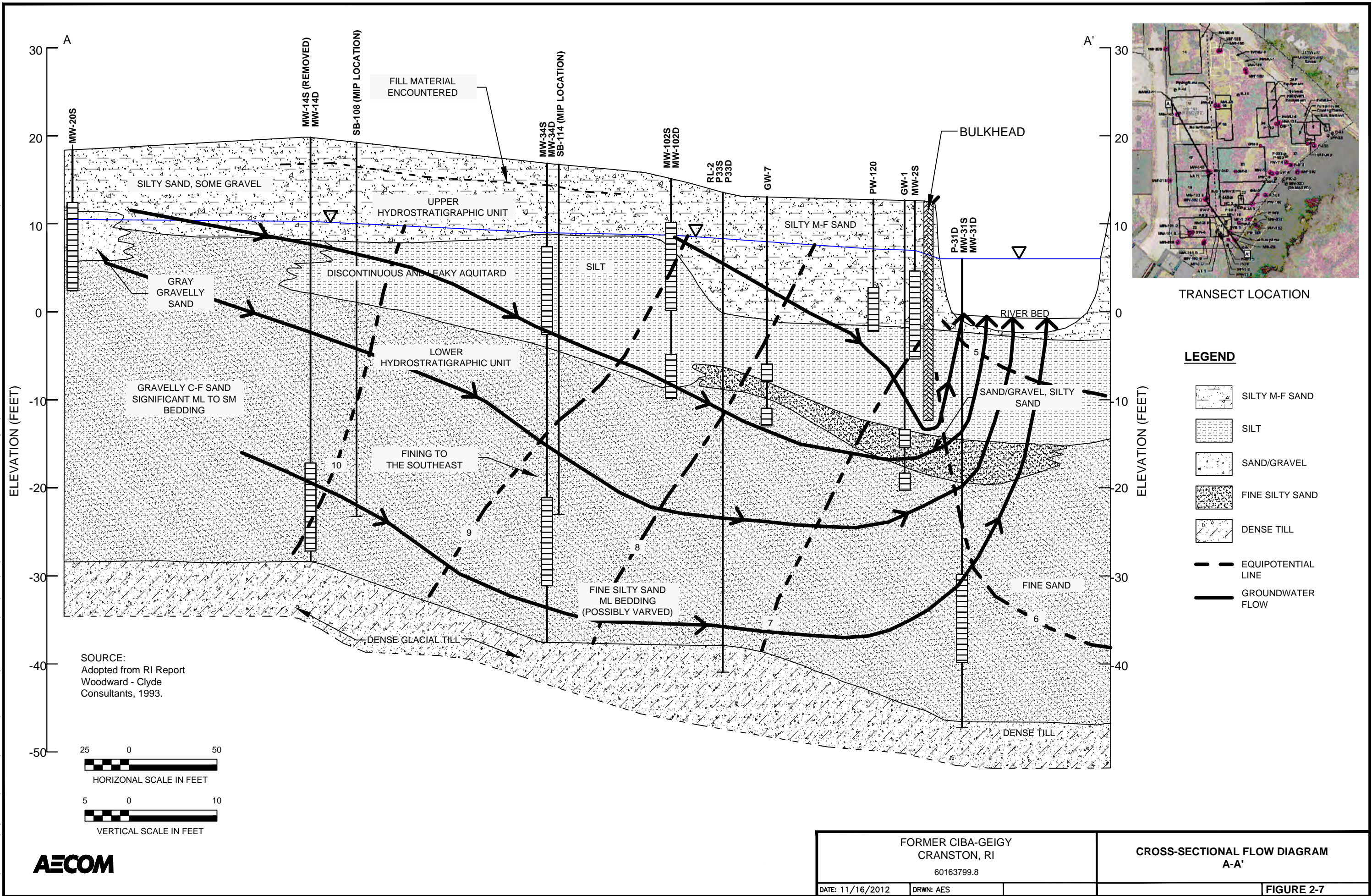




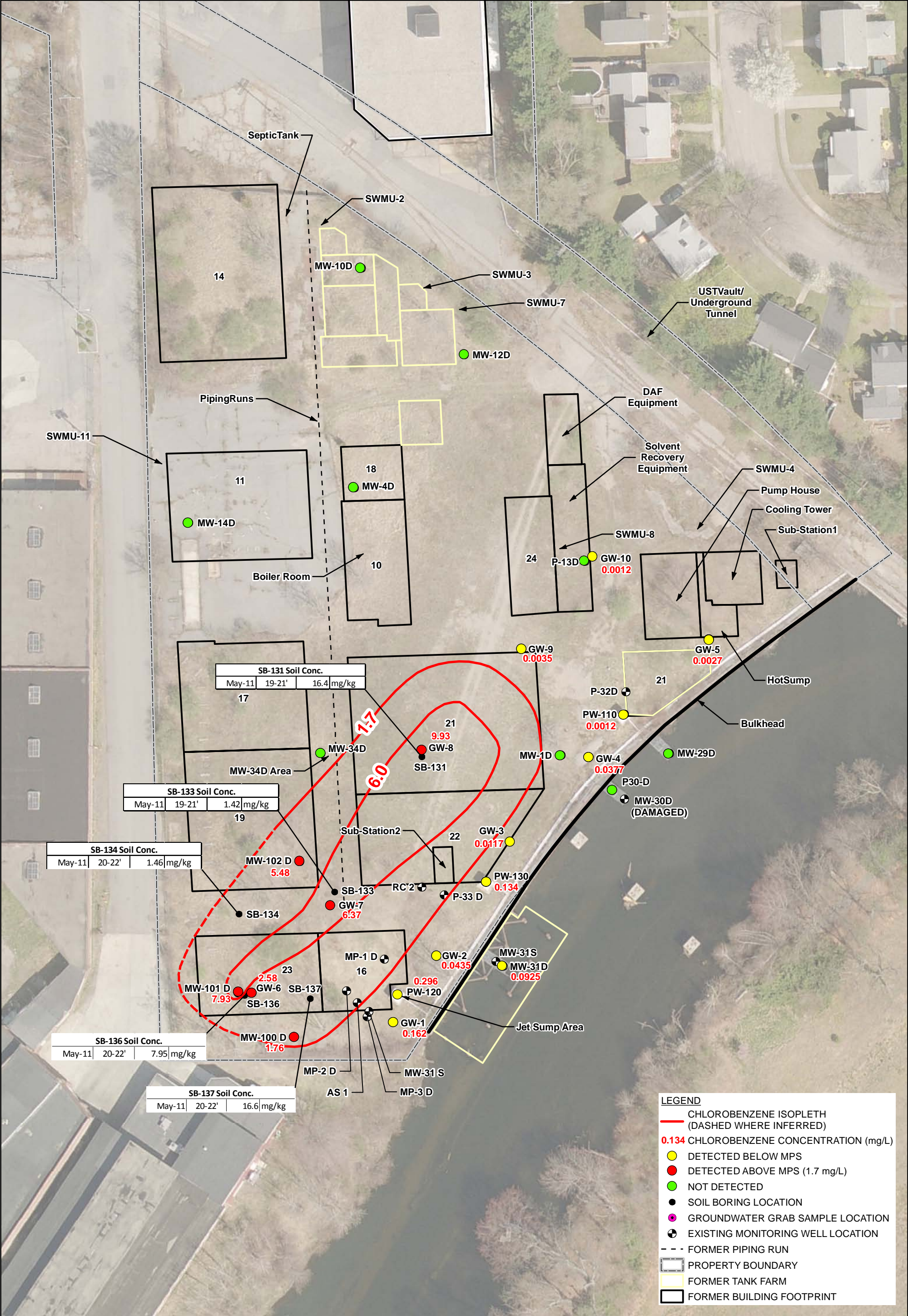
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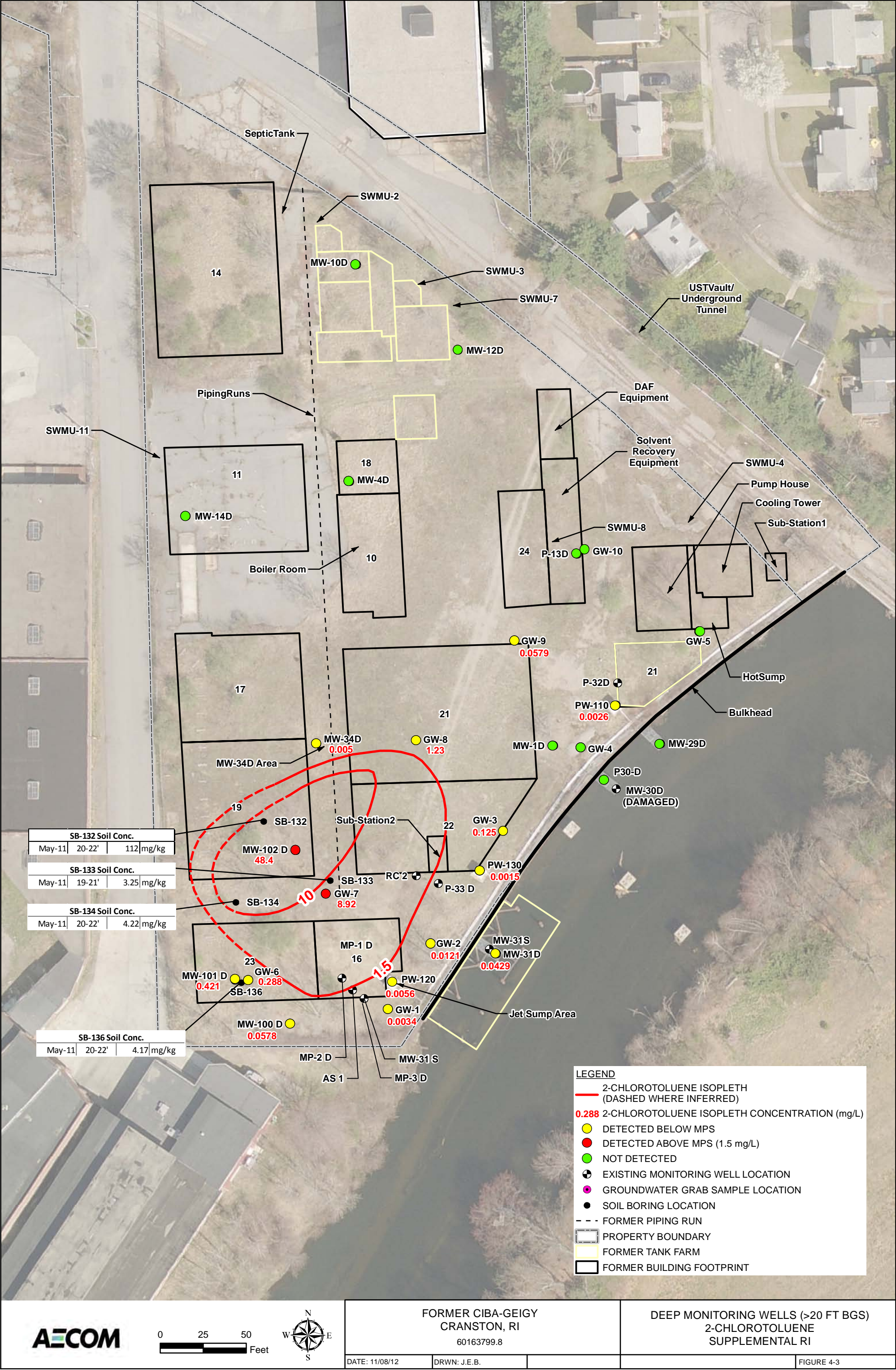
- EXISTING MONITORING WELL LOCATION
- FORMER PIPING RUN
- PROPERTY BOUNDARY
- FORMER TANK FARM
- FORMER BUILDING FOOTPRINT

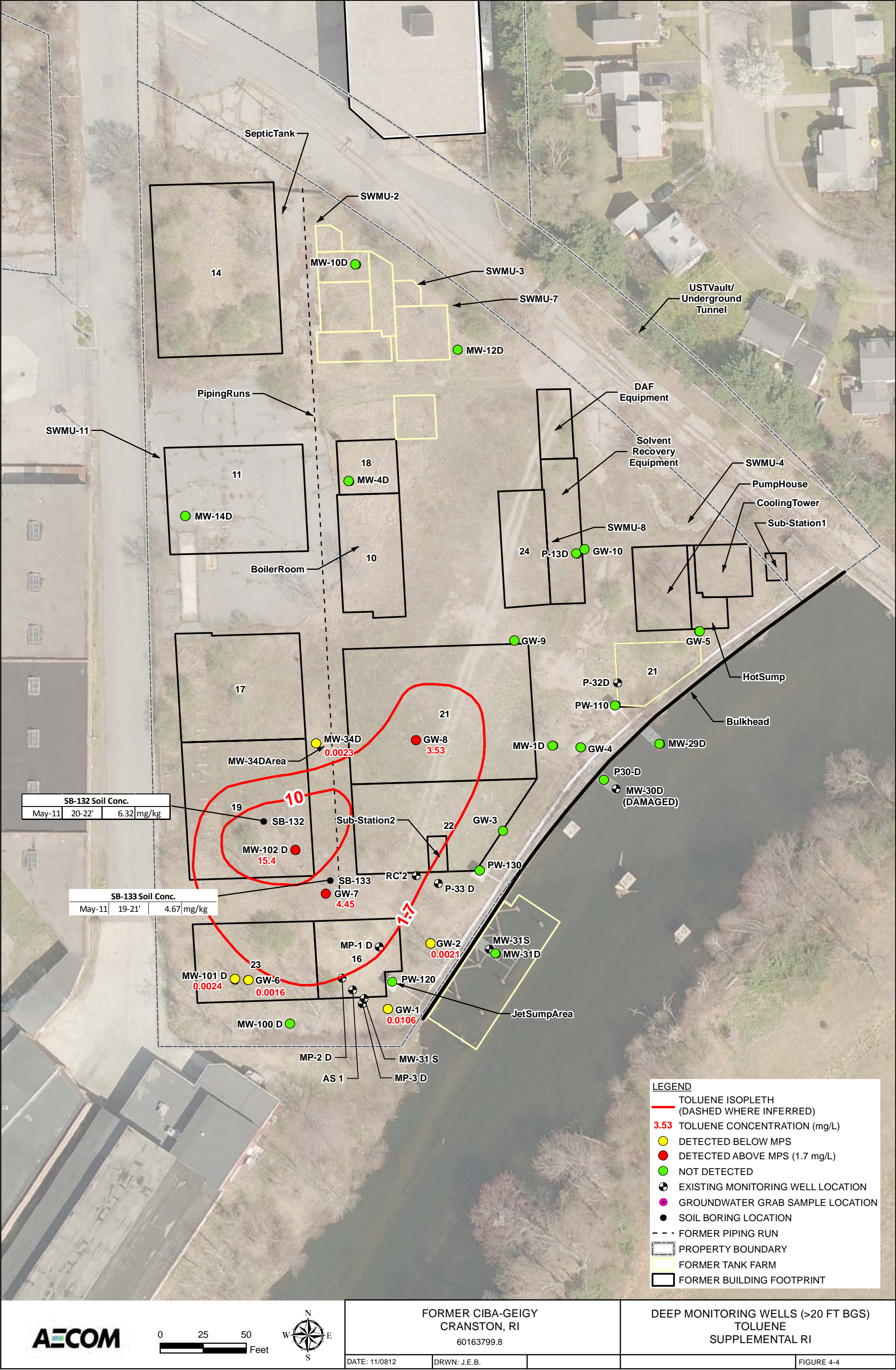
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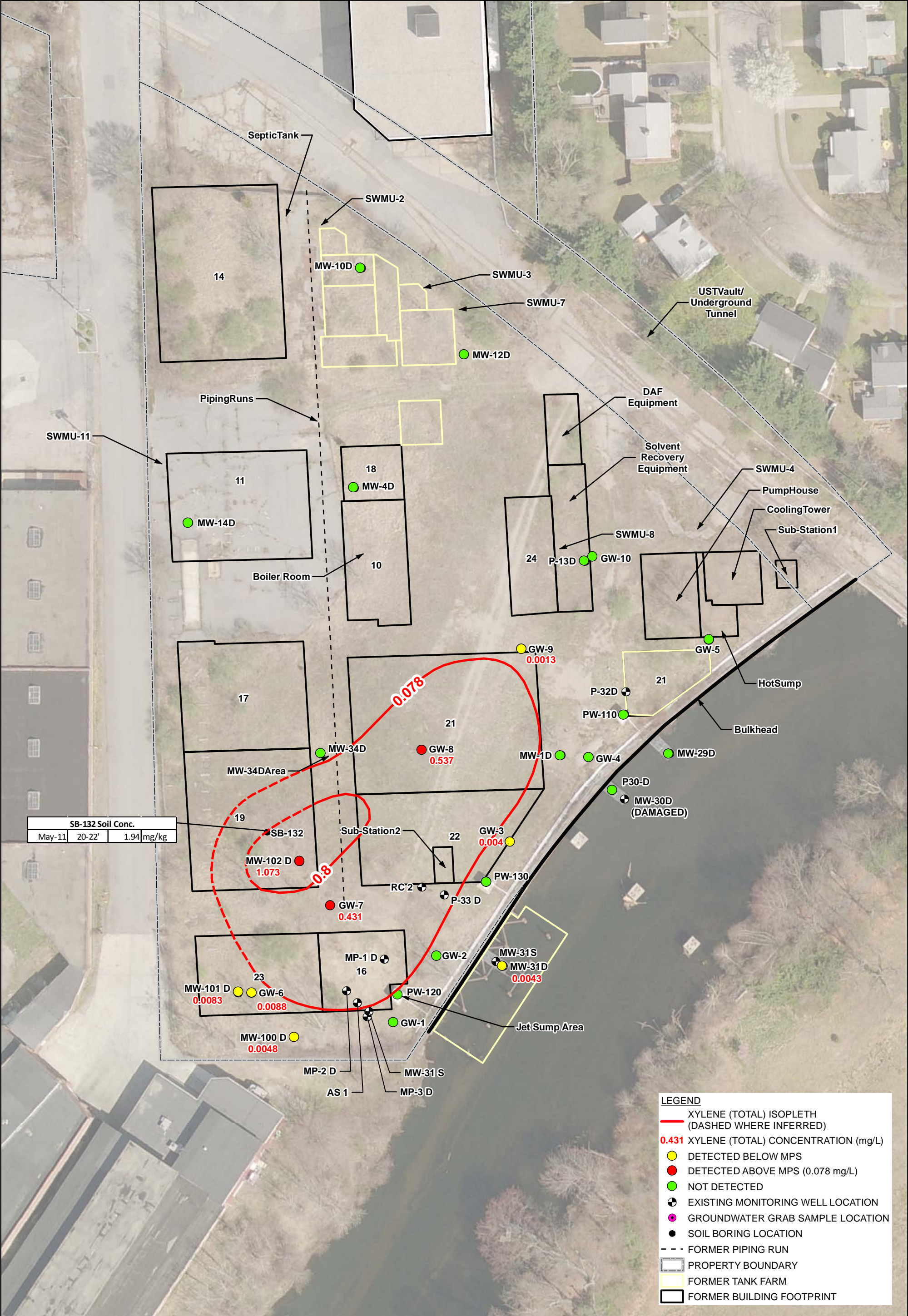






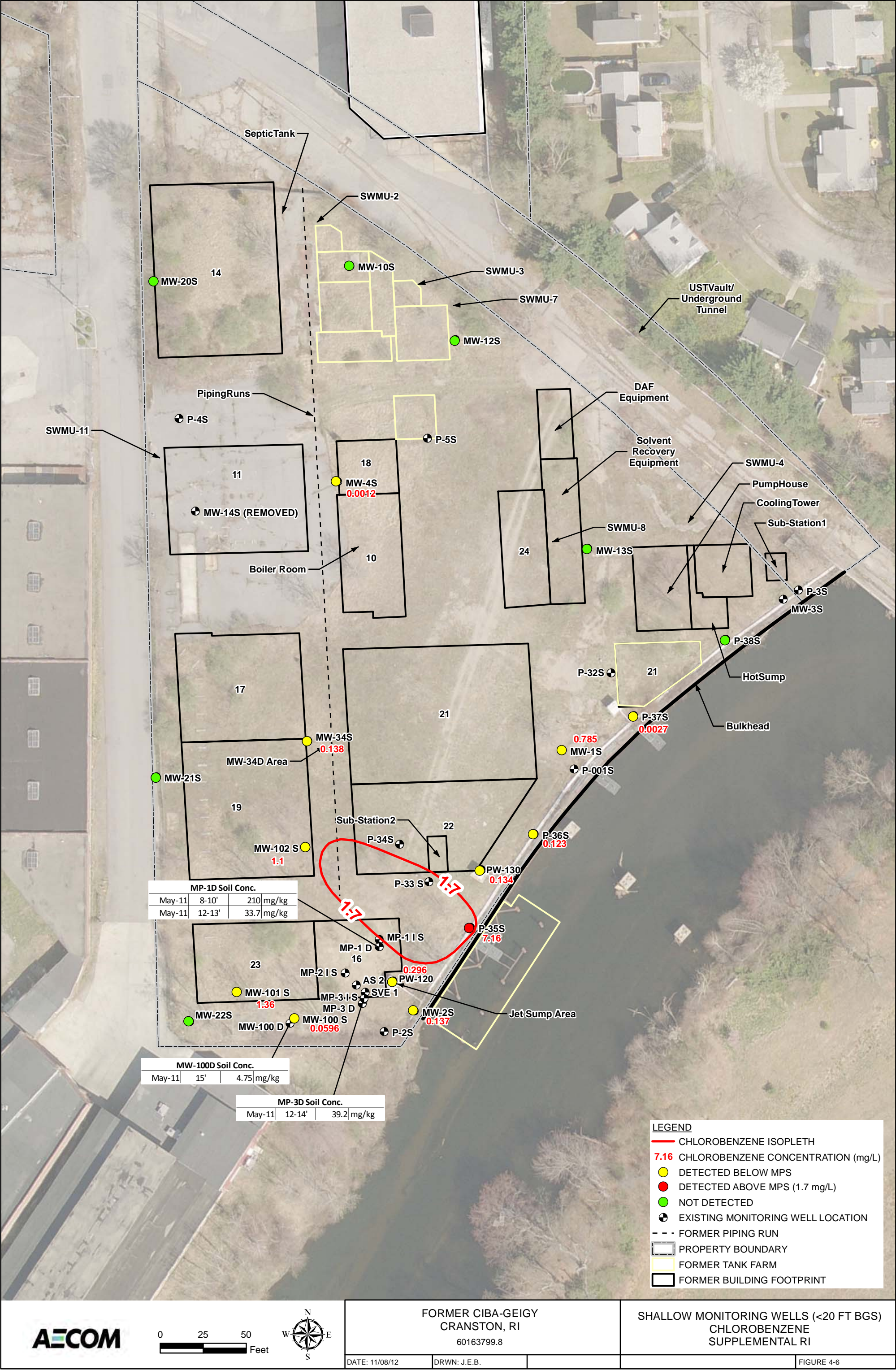


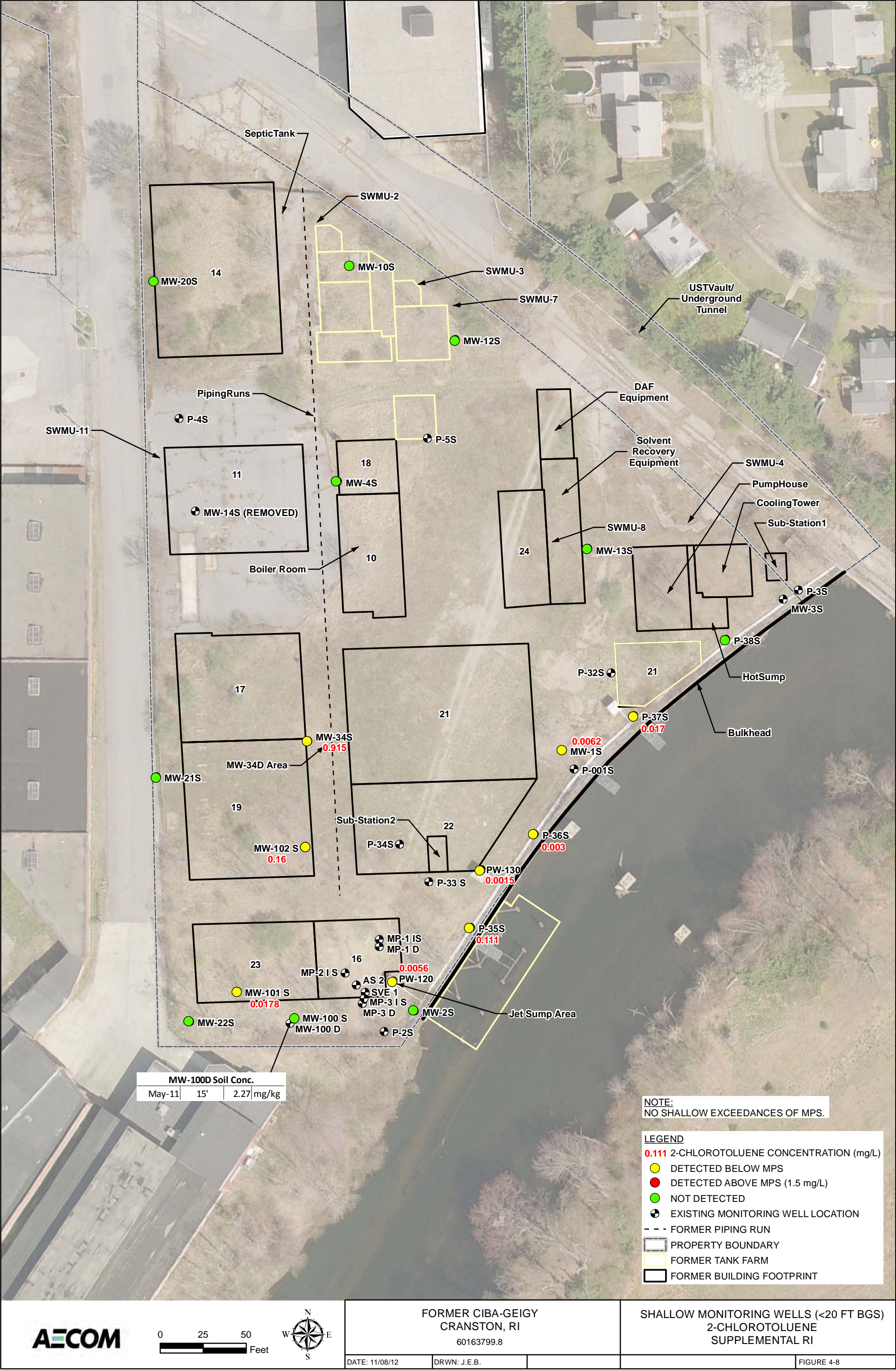




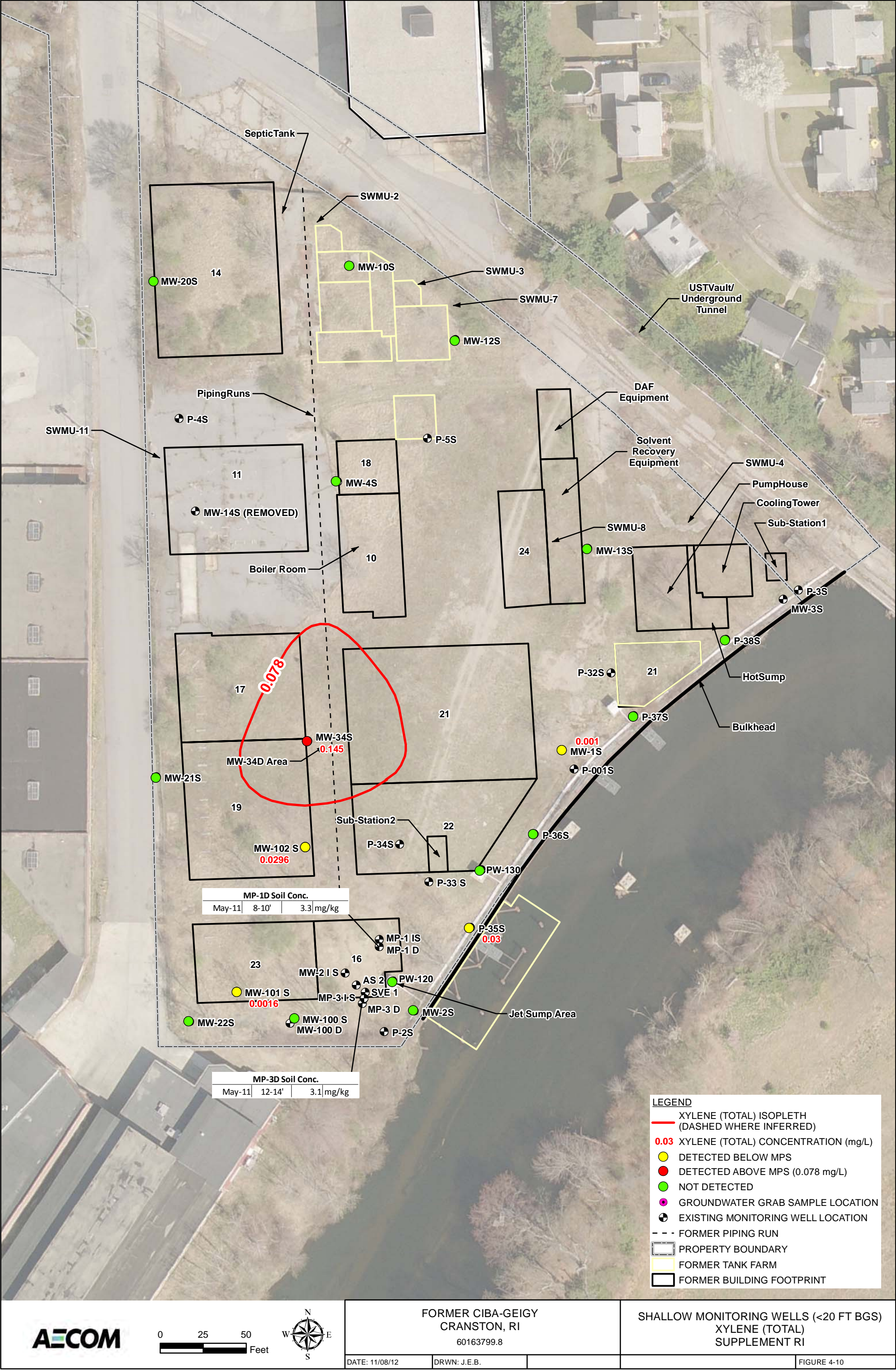
LEGEND

- XYLENE (TOTAL) ISOPLETH (DASHED WHERE INFERRED)
- 0.431 XYLENE (TOTAL) CONCENTRATION (mg/L)
- DETECTED BELOW MPS
- DETECTED ABOVE MPS (0.078 mg/L)
- NOT DETECTED
- EXISTING MONITORING WELL LOCATION
- GROUNDWATER GRAB SAMPLE LOCATION
- SOIL BORING LOCATION
- FORMER PIPING RUN
- PROPERTY BOUNDARY
- FORMER TANK FARM
- FORMER BUILDING FOOTPRINT

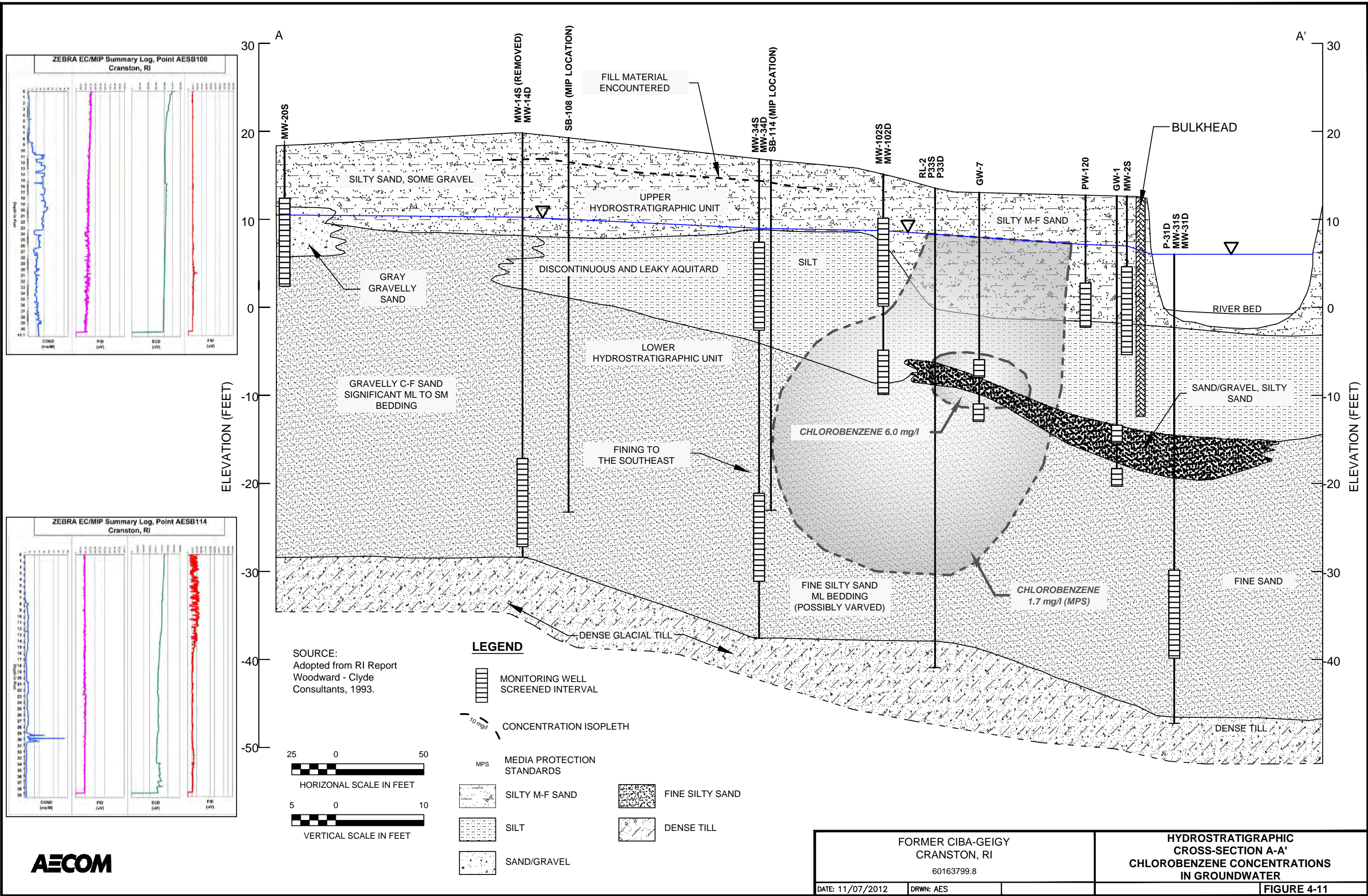




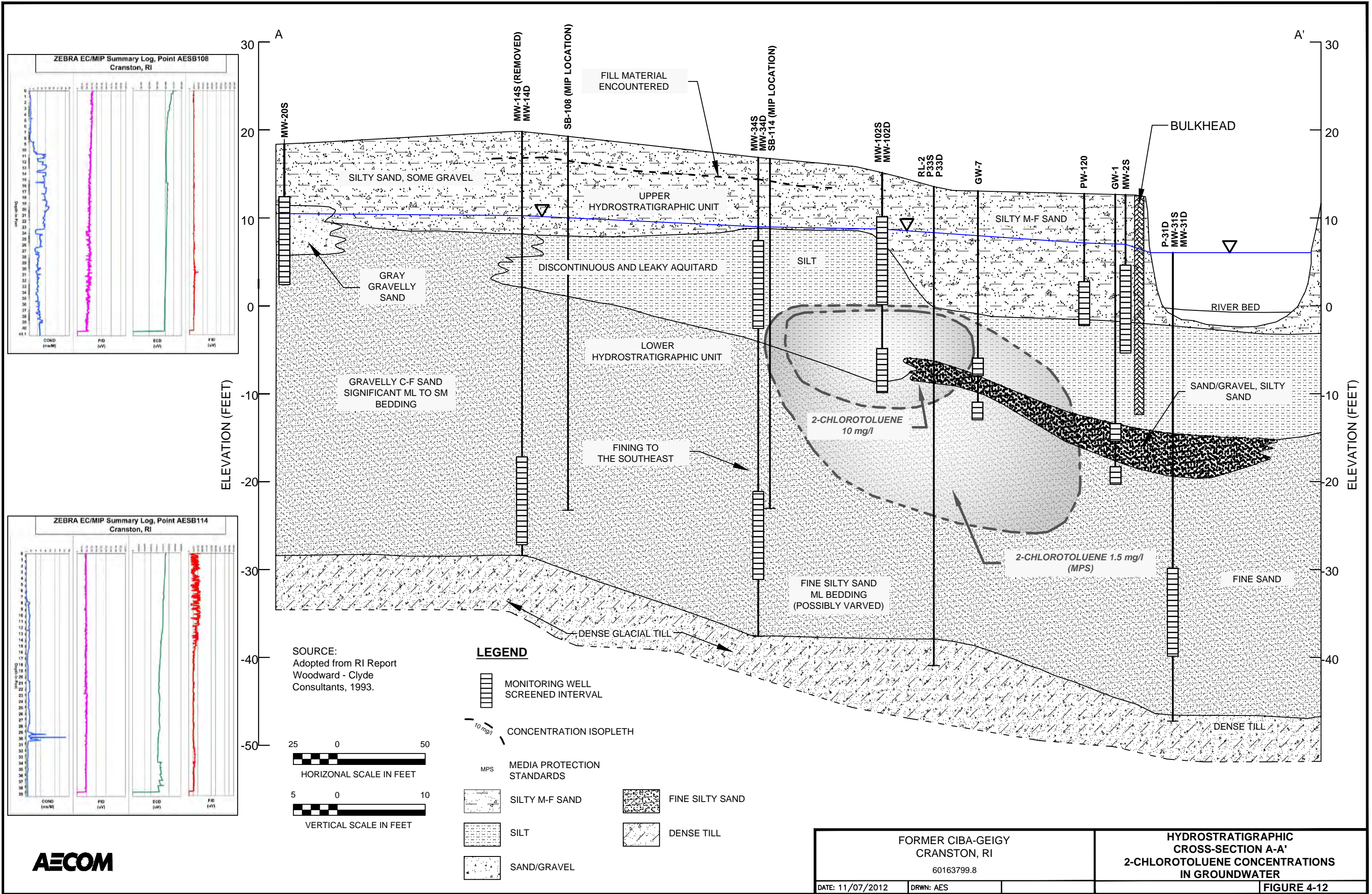




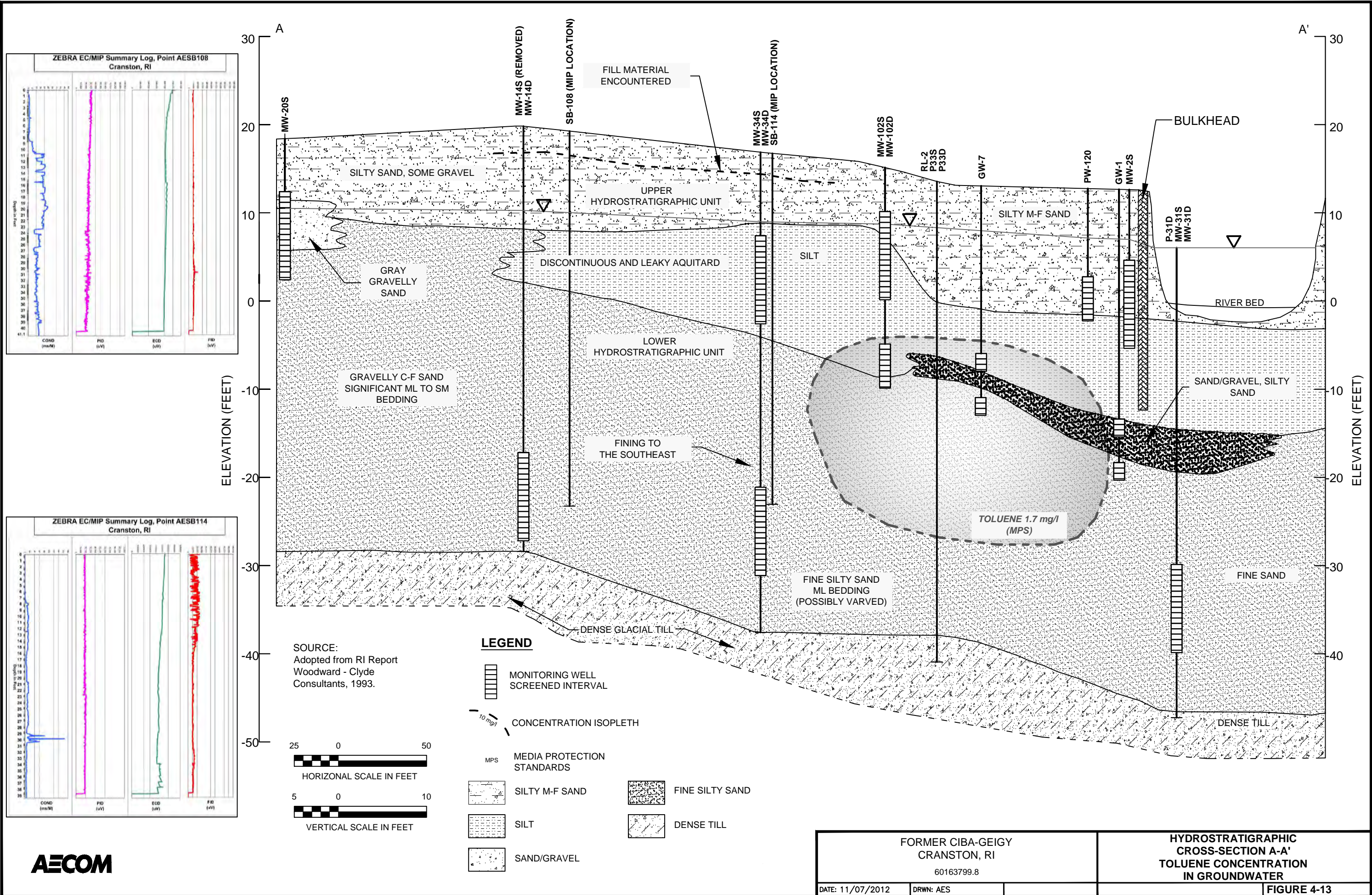
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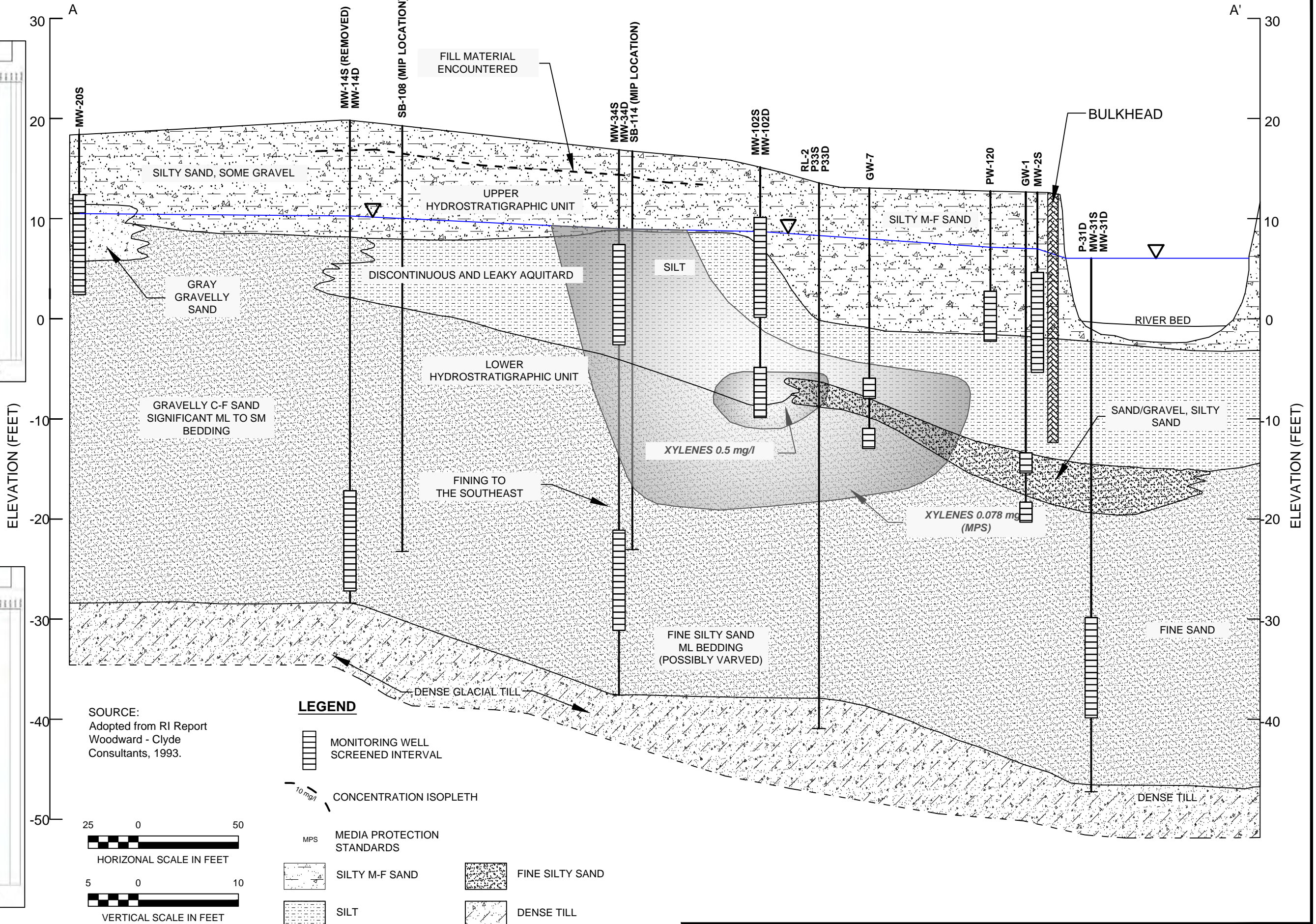
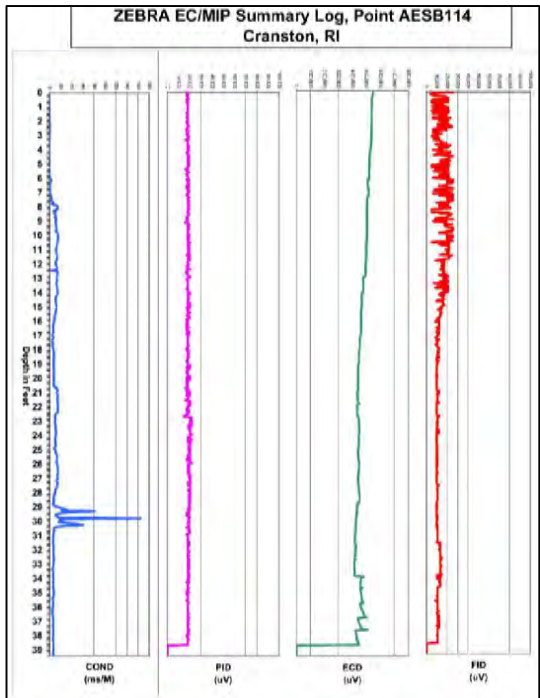
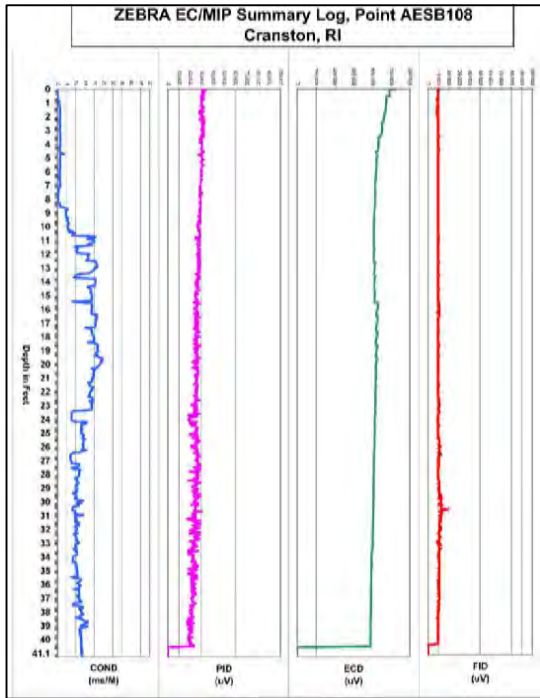


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SOURCE:
Adopted from RI Report
Woodward - Clyde
Consultants, 1993.

25 0 50
HORIZONTAL SCALE IN FEET

5 0 10
VERTICAL SCALE IN FEET

- LEGEND**
- MONITORING WELL SCREENED INTERVAL
 - CONCENTRATION ISOPLETH 10 mg/l
 - MPS MEDIA PROTECTION STANDARDS
 - SILTY M-F SAND
 - SILT
 - SAND/GRAVEL
 - FINE SILTY SAND
 - DENSE TILL



